AD-A141 213 MISSISSIPPI RIVER BATON ROUGE TO THE GULF LOUISIANA PROJECT SUPPLEMENT II(U) ARMY ENGINEER DISTRICT NEW ORLEANS LA APR 84 1/5

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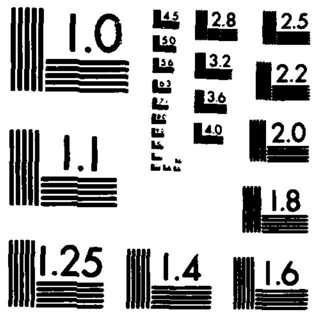


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US Army Corps of Engineers
New Orleans District

April 1984

AD-A141 213

# MISSISSIPPI RIVER, BATON ROUGE TO THE GULF LOUISIANA, PROJECT

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## DRAFT ENVIRONMENTAL IMPACT STATEMENT SUPPLEMENT II

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ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT II

MISSISSIPPI RIVER, BATON ROUGE TO THE GULF,
LOUISIANA, PROJECT
PLAQUEMINES PARISH, LOUISIANA

Lead Agency: U. S. Army Corps of Engineers
New Orleans District
April 1984

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ABSTRACT

This draft EIS Supplement II has been prepared to address recommended features to be added to the existing "Mississippi River, Baton Rouge to the Gulf, Louisiana," project. These recommended features were not addressed in the final EIS Supplement I filed with the Council on Environmental Quality (CEQ) on March 19, 1976, or the original final EIS filed with CEQ on June 26, 1974. Copies of these previously filed documents may be obtained for a charge from : Information Resources Press, 1700 North Moore Street, Arlington, VA 22209, (703) 558-8270.

The active delta of the Mississippi River is located in the southern-most portion of Plaquemines Parish, Louisiana. Since 1963, the New Orleans District has maintained, by dredging, a 40-foot deep navigational channel through this active delta to Baton Rouge, Louisiana. In recent years, shoaling and associated dredging have increased within the active-delta reach of the navigational channel. This shoaling increase has been a result of continuing deterioration of the river banks within the delta, as a result of subsidence and erosion. Projections indicate that, in approximately 26 years, shoaling would increase to a point where the 40-foot channel depth could not be maintained. The recommended features would provide for restoration and maintenance of the river bank. This would result in a reduction of shoaling to 12.7 million cubic yards which would be 7.3 million cubic yards less than what presently occurs. Shoal material, not needed for construction or maintenance of the recommended project features, would be disposed into adjacent estuarine water bodies. A minimum of 9,000 acres of marsh would develop from this unconfined disposal and, as a result, the recommended project would not require fish and wildlife mitigation.


Date: JUL 20 1984

Please send your comments to the District Engineer by the date stamped above. If you would like further information, please contact Mr. David Carney, U. S. Army Engineers District, New Orleans, P. O. Box 60267, New Orleans, Louisiana 70160. Commercial telephone: (504) 838-2528 or FTS telephone: 8 (504) 838-2528.

# 1.0. SUMMARY

## 1.1. MAJOR CONCLUSIONS AND FINDINGS

1.1.1. A final EIS addressing the features of the "Mississippi River, Baton Rouge to the Gulf, Louisiana," project was filed with the Council on Environmental Quality (CEQ) on June 26, 1974. On March 19, 1976, the final EIS Supplement I was filed with CEQ addressing new dredged-material disposal areas not included as features of the project when the original EIS was prepared. This draft EIS Supplement II has been prepared to address new features which have been recommended for inclusion into the "Mississippi River, Baton Rouge to the Gulf, Louisiana," project.

1.1.2. The purpose of the recommended project is to restore the banks of the Mississippi River below Venice, Louisiana, and Southwest Pass in order to confine more water to the navigational channel and, thus, reduce shoaling. This project purpose would be accomplished through bank nourishment and the construction and maintenance of foreshore dikes, jetties, and inner bulkheads. Lateral pile dikes might also be constructed for this purpose. Freshwater outlets would be constructed to allow continued, but controlled, freshwater flows to areas adjacent to the navigational channel. Marsh would be created as a by-product of the unconfined disposal of shoal material not needed for construction or maintenance of the project features. The current annual dredging requirement in the navigational channel is 20 million cubic yards. This annual dredging requirement would increase to 54.2 million cubic yards, in 26 years, under without project conditions. With the recommended project features in place, annual dredging quantities would be reduced to 12.7 million cubic yards. In addition, $942 million in average annual savings in navigational costs would be realized by project implementation. The total cost of project features would be $341 million. Benefit cost ratios of 27.3 to 1 or 13.4 to 1 would result from interest rates of 2 5/8 percent and 8 1/8 percent, respectively.

1.1.3. No fish and wildlife mitigation would be required as a result of construction and maintenance of the recommended project, as discussed in Appendix H, "Draft Fish and Wildlife Coordination Act Report."

1.1.4. Based on information contained in Appendix B, "Biological Assessment of Endangered/Threatened Species," construction and maintenance of the recommended project would not jeopardize the existence of any endangered and/or threatened species or critical habitat.

1.1.5. Based on Appendix F, "Section 404 (b)(1) Evaluation," the proposed disposal sites for the discharge of dredged material are specified as complying with the requirements of the Section 404 guidelines with the inclusion of appropriate and practical conditions to minimize pollution and adverse impacts on the affected aquatic ecosystem. A Water Quality Certificate from the State of Louisiana would be obtained prior to initiation of project construction.

1.1.6. Results of an analysis of wetland impacts, as required under Executive Order 11990, revealed that the creation of between 9,000 and 13,600 acres of marsh would be associated with maintenance of the recommended project.

1.1.7. Results of an analysis of floodplain impacts, as required by Executive Order 11988, revealed that construction and maintenance of the recommended project would not significantly impact floodplain functions.

1.1.8. The recommended project has been determined to be consistent with the Louisiana Coastal Resources Program, as discussed in Appendix G, "Consistency Determination - Louisiana Coastal Resources Program."

## 1.2. AREAS OF CONTROVERSY AND UNRESOLVED ISSUES

There have been no issues of major disagreement among public interests to date.

TABLE 1.3.

RELATIONSHIP OF PROJECT TO ENVIRONMENTAL REQUIREMENTS1/

| FEDERAL POLICIES | RECOMMENDED PROJECT |
|---|---|
| Archeological and Resources Protection Act | Full2/ |
| Clean Air Act | Full |
| Clean Water Act | Full2/ |
| Coastal Zone Management Act | Full2/ |
| Endangered Species Act | Full2/ |
| Estuary Protection Act | Full2/ |
| Federal Water Project Recreation Act | Full2/ |
| Fish and Wildlife Coordination Act | Full2/ |
| Flood Plain Management (E.O. 11988) | Full2/ |
| Historic Sites Act of 1935 | Not Applicable |
| Land and Water Conservation Fund Act | Not Applicable |
| Marine Mammal Protection Act | Full2/ |
| Marine Protection Research and Sanctuaries Act | Not Applicable |
| National Environmental Policy Act | Full2/ |
| National Historic Preservation Act | Full3/ |
| Prime and Unique Farmlands, CEQ Memorandum | Full2/ |
| Protection and Enhancement of the Cultural Environment (E.O. 11593) | Full2/ |
| Protection of Wetlands (E.O. 11990) | Full2/ |
| River, Harbor, and Flood Control Act of 1970, Section 122 | Full2/ |
| Water Resources Planning Act | Full2/ |
| Watershed Protection and Flood Prevention Act | Not Applicable |
| Wild and Scenic Rivers Act | Resource Not in Project Area |
| **STATE POLICIES** | |
| Air Control Act | Full2/ |
| Archeological Treasure Act | Full4/ |
| Historic Preservation Districts Act | Not Applicable |
| Louisiana Natural and Scenic Rivers Act | Resource Not in Project Area |
| Protection of Cypress Trees (ACT 795) | Full2/ |
| Water Control Act | Full2/ |
| **LAND USE PLANS** | |
| Louisiana Coastal Resources Program | Full2/ |

1/ This table displays the level of compliance of the recommended project with applicable Federal and state environmental laws, regulations, executive orders, and land-use plans.

2/ Full compliance at this stage of the project would be achieved through review of this draft EIS Supplement II by the interested public.

3/ A determination of the eligibility of the Burrwood site for inclusion on the National Register of Historic Places has been initiated, as provided under the National Historic Preservation Act. Therefore, the foreshore dike in the vicinity of the Burrwood site would be aligned and constructed so as to avoid destruction of standing and submerged cultural features associated with the site.

4/ No recovery or salvage operations are anticipated at this time. If such operations become necessary, compliance with all provisions of the Act would be completed.

## 2.0. TABLE OF CONTENTS

## 3.0. PURPOSE AND NEED FOR PROJECT

### 3.1. PROJECT AUTHORITY

Congressional authority for construction of the "Mississippi River, Baton Rouge to the Gulf of Mexico, Louisiana," project is contained in the River and Harbor Act of 2 March 1945 (Public Law 14, 79th Congress, 1st Session). The Act authorizes construction in accordance with the plans recommended in the report of the Chief of Engineers printed in H.D. 215, 76th Congress, 1st Session.

### 3.2. PURPOSE AND NEED

3.2.1. The Mississippi River, between the Gulf of Mexico and Baton Rouge, Louisiana, currently provides a navigational channel with a project-authorized depth of 40 feet. While both shallow and deep-draft navigational interests use the river efficiently, maintenance of the Mississippi River and Southwest Pass at 40 feet is entirely a function of the needs of deep-draft navigation. Over the nearly two decades since a 40-foot channel in the Mississippi River was achieved, continued maintenance of that depth has insured a vital and growing port corridor with New Orleans and Baton Rouge boasting the first and sixth largest ports in the nation, respectively, as ranked by tonnage in 1981. The immense importance of the river corridor to agriculture alone can be understood in that 38.8 percent of all 1980 United States waterborne grain exports used the Mississippi River between Baton Rouge and the Gulf of Mexico. Continued maintenance of the current dimensions of the river are vital to the continued growth and health of the industries and commerce it serves.

3.2.2. The maintenance of Southwest Pass is becoming a more complex problem. Future large maintenance dredging increases would be experienced in Southwest Pass and the Mississippi River below Venice, Louisiana, as a result of the rapid subsidence of the banks of the river and pass. The subsidence of

these banks, and the associated loss of river water over them, results in increased shoaling within the pass and river. As the hydraulic characteristics of the pass and river deteriorate in the future, and shoaling continues to increase, river traffic would become even more constrained and maintenance costs would rise. The purpose of the recommended project is to restore the subsided banks which would reduce the loss of river water and cause an increase in river-water velocities. These increased velocities would decrease shoaling and, thus, maintain the navigability of the pass and river.

## 4.0. ALTERNATIVES

### 4.1. RECOMMENDED PROJECT

#### 4.1.1. General

4.1.1.1. Hydraulic model studies have been conducted by the U. S. Army Corps of Engineers' Waterways Experiment Station to evaluate various features proposed to reduce maintenance dredging in the 40-foot navigational channel between Venice, Louisiana, and the gulf. Sediment traps, friction chambers, and recurvature of the navigational channel are features which have been evaluated in these model studies. These features, or modifications thereto, have not been proven fully effective at this time and, therefore, were not addressed in this EIS. If subsequent studies prove these features to be effective, they would be addressed in a future document.

4.1.1.2. Although only one project alternative is addressed in this EIS, it should be recognized that the recommended project represents a combination of features which, as experience has shown, are effective alternative means of maintaining the 40-foot navigational channel. The recommended project consists of foreshore dikes, bank nourishment, freshwater outlets, jetty stabilization, and inner bulkheads (see Plates 2 through 20). Lateral pile dikes, although not presently recommended, are also addressed in this EIS as structures that could potentially be built in the future (see Plate 24). Construction of project features would begin in 1985 and end in 1992. The effective life of the recommended project would be 50 years, ending in 2042. Economic and environmental analyses are based on this estimated effective life. Marsh creation, which would be the result of the unconfined disposal of shoal material, would continue as part of the 40-foot navigational channel maintenance program to 2042. No construction schedule exists for the lateral pile dikes. Table 4.1.1. displays the dimensions of, and acres affected by, the project features.

TABLE 4.1.1.

PROJECT FEATURE DIMENSIONS[1/] AND ACRES OF HABITAT AFFECTED

| Feature | Length | Width | Height | Acres Affected |
|---|---|---|---|---|
| Foreshore Dikes | 35.0 miles | 90 feet (bottom width) | +7.0 to +7.5 NGVD[2/] | 225 acres of river bottom |
| Bank Nourishment | 35.0 miles | 100 to 200 feet (bottom width) | +4.0 to +4.5 NGVD | 1,250 acres of river bottom |
| Freshwater Outlets | 200 feet | 100 feet (five outlets)<br>700 feet (one outlet) | 0.0 NGVD<br>(crest elevation) | 25 acres of river bottom and scrub/shrub uplands |
| Jetties | 5.0 miles | 100 feet (bottom width) | +6.0 NGVD | 3/ |
| Inner Bulkheads | 5.5 miles | 30 feet (bottom width) | +6.0 NGVD | " |
| Fill between Jetties and Bulkheads | 5.0 miles | 900 feet (bottom width) | +4.0 NGVD | 600 acres of water bottom |
| Lateral Pile Dikes | 16,000 feet | 20 feet (bottom width) | +6.0 NGVD | 900 acres of river bottom |

1/ All dimensions are approximate and might vary in specific areas. Refer to the EIS plates for more detailed information.

2/ National Geodetic Vertical Datum

3/ The acres-affected total for this feature is included in the 600-acre value given for the "Fill between Jetties and Bulkheads" feature.

4.1.2. Foreshore Dikes

Plates 2, 3, and 4 display the design of the foreshore dikes. Plates 6 through 19 display the locations of this feature within the Mississippi River and Southwest Pass. The centerline of the foreshore dike would be aligned with the -2.5-foot National Geodetic Vertical Datum (NGVD) contour for the reach in the Mississippi River between Venice, Louisiana, and Head of Passes (Mile 0 of the Mississippi River). In Southwest Pass, the foreshore dikes would be aligned with the -1.8-foot NGVD contour (weighted average). Plate 2 reveals that the initial height of foreshore dikes in the Mississippi River between Venice and Head of Passes would be +11.0 feet NGVD, while in Southwest Pass they would be between +10.0 feet NGVD and +10.5 feet NGVD. The design heights of the dikes would be +7.5 feet NGVD in the Mississippi River between Venice and Head of Passes and +7.0 feet NGVD in Southwest Pass. The dikes would be approximately 90 feet wide (weighted average) at their bases. Flotation channels would be dredged adjacent to the foreshore dikes to provide access for construction and maintenance equipment. These channels would be bucket dredged to a depth of -8.0 feet NGVD. Approximately two million cubic yards of dredged material would be excavated for construction of these flotation channels. This dredged material would be deposited by bucket dredge, riverward of the flotation channels rather than bayward of the foreshore dikes. The flotation channels and disposed dredged material would occupy a 150-foot wide area, parallel to and riverward of the foreshore dikes.

4.1.3. Bank Nourishment

Plate 4 displays the design of the bank nourishment. Plates 6 through 19 display the locations of this feature within the Mississippi River and Southwest Pass. Immediately after constructing a specific section of foreshore dike, or raising an existing rock dike, hydraulically dredged material would be pumped bayward of the foreshore

dikes as fill. Together, the foreshore dikes and bank nourishment would serve to create new river and pass banks which confine more water to the channel and, thus keep dredging requirements within practicable limits. This fill or bank nourishment would be pumped to design elevations of +4.5 feet NGVD between Venice and Head of Passes and +4.0 feet NGVD in Southwest Pass. These design elevations for the bank nourishment would be achieved by pumping the dredged material to initial elevations of approximately +7.5 feet NGVD and +7.0 feet NGVD, respectively. The design elevations could be attained in 1 to 6 years from construction. This time estimate refers to initial pumping elevations and initial consolidation periods. Subsequent periodic disposal would be required to maintain the design elevations. Subsequent pumping elevations would be determined using field instrumentation observations. The bank nourishment would extend bayward from the foreshore dikes to the existing Mississippi River or Southwest Pass banks. In areas where no banks exist, the bank nourishment would extend bayward for 200 feet at the design elevation and then be allowed to assume an approximate 1-foot vertical to 50-foot horizontal slope. The total in-place fill required for bank nourishment below Head of Passes (BHP) would be 12 million cubic yards. Projected annual maintenance quantities in Southwest Pass indicate that sufficient amounts of material would be available for construction of bank nourishment. There is a degree of uncertainty and variability in the probable locations of future maintenance work in Southwest Pass. Because of this uncertainty, and if efforts to maximize acquisition of fill material during maintenance dredging operations proves insufficient, the channel would be used as a borrow area. Dredging for adequate amounts of material for bank nourishment would not likely exceed a maximum depth of 55 feet. Bank nourishment Above Head of Passes (AHP) would require 6.3 million cubic yards of in-place fill. Projected maintenance quantities for the immediate future would not provide sufficient amounts of material for bank nourishment. Approximately 6 million cubic yards would be available from the existing channel limits down to a depth of 55 feet.

Additional borrow areas would provide 1.7 million cubic yards between miles 8.0 and 10.0 AHP and 1.8 million cubic yards between miles 3.5 and 6.0 AHP. Borrow areas are shown on Plates 6 through 9.

### 4.1.4. Freshwater Outlets

Plate 3 displays the design of the freshwater outlets. Plates 8 and 9 display the locations of these outlets within the project area. Four low-weir rock structures or outlets, each 100 feet wide, would be built into the foreshore dike on the west side of the Mississippi River at miles 2.9, 3.5, 5.5, and 7.1 between Venice and Head of Passes. These outlets would have crest elevations of 0.0 feet NGVD. The two existing outlets in the east bank of the Mississippi River at miles 4.9 and 6.45 between Venice and Head of Passes would remain open, and the foreshore dike to be constructed at these locations would tie into the existing bank. The purpose of these six outlets would be to maintain year-round freshwater inflow to areas that would otherwise be isolated from inflow, except during high-water season in April and May, once the dikes and bank nourishment were constructed. Existing low-flows to the east would be maintained while 50 percent of existing low-flows would be provided to the west. These outlets would allow the diversion of river water in a manner and amount that would be consistent with the overall project purpose of reducing shoaling within the 40-foot navigational channel.

### 4.1.5. Jetty Stabilization

Plates 4A and 4B display the design of the east and west jetties. Plates 19 and 20 display the locations of these jetties at the mouth of Southwest Pass. "Dolosse," concrete armor units weighing 3 1/2 tons, would be used to construct the jetties. The height of the jetties would be +6.0 feet NGVD with a crown width of 25 feet. The maximum bottom width of the jetties would be approximately 100 feet. Maintenance

channels would be constructed riverward of the jetties to provide access for jetty-maintenance equipment.

### 4.1.6. Inner Bulkheads

Plate 4A displays the design of the east and west inner bulkheads. Plates 19 and 20 display the locations of these bulkheads at the mouth of Southwest Pass. The bulkheads would be constructed of prestressed concrete piles, with an outer diameter of 36 inches. The design height of the inner bulkheads would be +6.0 feet NGVD. Approximately 7 million cubic yards of hydraulically dredged material would be pumped as fill between the inner bulkheads and the jetties. The design height of this fill would be +4.0 feet NGVD.

### 4.1.7. Lateral Pile Dikes

Plates 24 and 25 display the design of lateral pile dikes. This type of dike has been used extensively in Southwest Pass to reduce the cross-sectional area of the pass, thus increasing flow velocities and reducing shoaling. Model testing is underway to determine if construction of new lateral pile dikes and extension of existing dikes, in addition to the other recommended features, would result in further shoaling reductions. Approximately 16,000 feet of new lateral pile dikes could be constructed. These dikes would vary from 300 to 1,000 feet long. On the west banks of the Mississippi River and Southwest Pass six new lateral pile dikes would be constructed between miles 0.6 BHP and 0.7 AHP while 29 existing lateral pile dikes, 24 between miles 10 BHP and 14.4 BHP and five between miles 19 BHP and 20 BHP, would be extended. On the east bank of Southwest Pass a total of 35 new lateral pile dikes would be constructed - nine between miles 1.8 BHP and 3.0 BHP and 26 between miles 10.3 BHP and 14.7 BHP.

4.1.8. Maintenance Procedures

4.1.8.1. Periodic maintenance of the foreshore dikes, bank nourishment, freshwater outlets, jetties, and inner bulkheads would be required over the project life. It is anticipated that a 7.3-million cubic yard reduction would be realized in annual maintenance quantities from the present average of 20 million to 12.7 million with the project in place. The 7.3 million cubic yard reduction would occur within the jetty reach of Southwest Pass. Shoaling quantities, as they are currently experienced in the other reaches of Southwest Pass and at the Head of Passes, would not change. The procedures used under the existing 40-foot channel maintenance program provide for the unconfined disposal of hydraulically dredged shoal material into open-water disposal areas. Marsh is created as a by-product of these existing disposal procedures. If the recommended project features are implemented, future maintenance dredging quantities, removed as a result of channel maintenance and not necessary for constructing or maintaining project features, would also be disposed into open-water disposal areas with marsh developing as a consequence.

4.1.8.2. Plate 21 displays the location and extent of marsh created (approximately 13,600 acres) under maintenance of the 40-foot channel, with the recommended project features in place. The figures on this plate represent the acres of marsh projected at year 2042. This marsh would be created as a by-product of the placement of unconfined dredged material within estuarine water bodies. Montz (1977) has determined that, in the vicinity of Southwest Pass, the maximum optimum elevation for marsh creation is +2.0 feet NGVD.

4.1.8.3. The marsh acreage figures on Plate 21 were estimated by considering a number of factors including the depositional environment of dredged materials, consolidation of foundation materials, subsidence, marsh accretion, and erosion. A disposal plan that maximized the time

in which the surface of the dredged material would be between +1.0 and +2.0 feet NGVD was used in these computations of marsh acreage. Marsh creation activities would be monitored by annual interagency inspections and the use of 1:24,000-scale color infrared photography which would be taken approximately every five years. Subsequent disposal elevations would be refined using field instrumentation observations.

4.1.8.4. The with-project marsh acreage total is considered to be an estimate of the maximum acreage of marsh that could be created. This marsh acreage could be less because experience has revealed that erosional forces along the east side of Southwest Pass, particularly below mile 8.8 BHP, are such that hydraulically dredged material tends not to accumulate when deposited into open water. In the other disposal areas on the west and east sides of the river and pass, 100 percent of the dredged material would not be retained in the unconfined disposal areas. This would result in reduced marsh acreages. The maximum estimates were based on the assumption that 100 percent of the dredged material would be used to create marsh and that the dredged material on the east side of Southwest Pass would not erode faster than on the west side. Using a retention rate of approximately 70 percent, a more conservative estimate of 9,000 acres of created marsh should be applied to the recommended project. This acreage was obtained by assuming that a minimum acreage of marsh would be created on the east side of Southwest Pass below mile 8.8. The acreage of created marsh probably would fall between this conservative 9,000-acre figure and the maximum figure of 13,600.

## 4.2. WITHOUT PROJECT CONDITIONS

4.2.1. If the recommended project features are not implemented, continued att[illegible] to maintain the navigational channel at a 40-foot depth would [illegible]ively less effective. Under present conditions, a 40-foot de[illegible] is available 70 percent of the time, as displayed

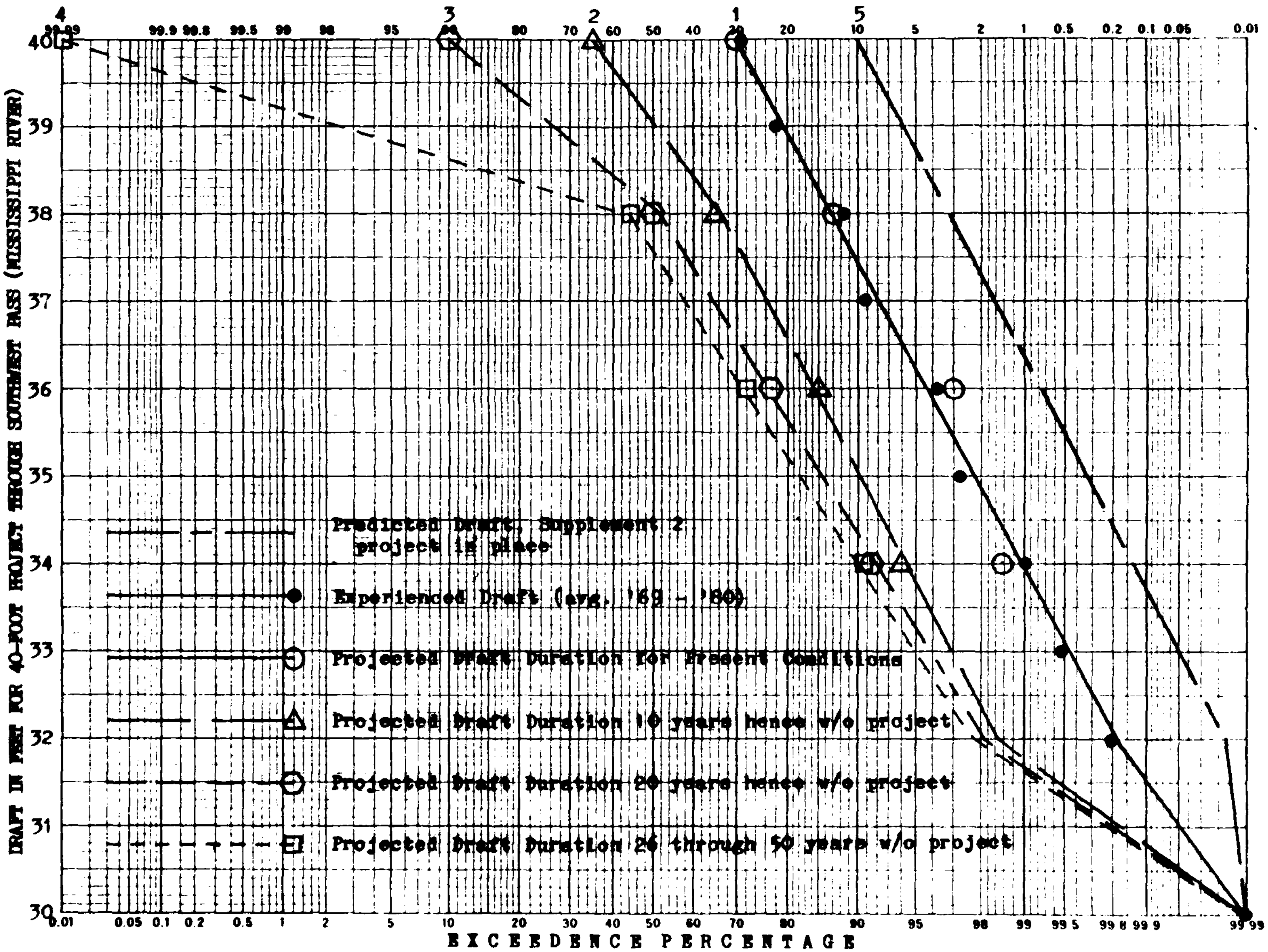
in Figure 4.2.1. Without the project, in 20 years a 40-foot deep channel would be available 10 percent of the time. With a continuously deteriorating channel, shipping interests would be forced to alter their method of operation, i.e., light loading, utilizing vessels of lesser draft, offshore lightering, or diversions to other ports. Any of these changes would create transportation inefficiencies with resulting increases in shipping costs. Localities to which any anticipated traffic might be diverted could experience economic growth; however, the overall net economic benefits of the nation's inland waterway system would be substantially reduced. Because port activities in New Orleans and Baton Rouge are so important to the project area's economic base, any general decline would have a depressing effect on the local economy. This would impact employment, income, property values, tax revenues, and the availability of public facilities and services. It would discourage community growth, regional growth, community cohesion, and cause displacement of people.

4.2.2. Future dredged-material disposal associated with maintenance dredging of the 40-foot navigational channel would result in the creation of between 23,000 and 28,400 acres of marsh by the year 2042. The same assumptions made concerning dredged-material retention discussed Paragraph 4.1.8.4. were used to develop the minimum marsh acreage figure. Plate 22 displays the location and maximum extent of marsh under without project conditions. The disposal of dredged material also would result in the creation of 14,000 acres of scrub/shrub uplands. These upland areas would be distributed in a discontinuous manner along the navigational channel. They would provide nesting habitat for seabirds and wading birds and would benefit various other species of wildlife.

4.2.3. Although isolated areas of marsh would accrete naturally, subsidence (including sea level rise) and erosion would cause the loss of 45,300 acres of marsh and 950 acres of natural levee forest and

FIGURE 4.2.1

DRAFT DURATION PROJECTION
MISSISSIPPI RIVER BATON ROUGE TO THE GULF



the concomitant gain of 46,250 acres of estuarine water bodies by the year 2042 (Wicker, 1980). These impacts would occur throughout the active delta of the Mississippi River and would be considered independent of the dredging and disposal activities associated with the 40-foot channel.

4.2.4. The creation of marsh and scrub/shrub uplands associated with the disposal of dredged material would be considered beneficial when viewed independently and would partially offset the marsh and natural levee forest losses that would occur within the active delta as a whole. The net loss of marsh, however, would result in a reduction of fish and wildlife productivity, thus reducing outdoor recreational opportunities and commercial fish and wildlife harvests. The Delta National Wildlife Refuge and the Pass a Loutre Waterfowl Management Area would be impacted adversely by this productivity decline. Endangered, threatened, and "*Blue-List*" species would follow present trends with some possible reduction in their food supplies resulting from the net habitat losses.

4.2.5. Sites eligible for inclusion into the National Register of Historic Places would be discovered as interest in the cultural resources of Louisiana increases. Because of shoaling, future-without project water quality would be influenced by increasing flows over the river banks and decreasing flows in the major distributaries. Salinities would be expected to continue increasing in the east delta while decreasing in the west delta. Contaminant loads and bioaccumulation potential could increase as a result of the creation of extensive areas of scrub/shrub upland and marsh adjacent to each other.

4.3. MITIGATION REQUIREMENTS

4.3.1. The U. S. Fish and Wildlife Service's "Habitat Evaluation Procedures" (HEP) was one method used to quantify the impacts of the

project features on wildlife resources and determine whether mitigation would be necessary. The HEP analysis compared future-without project conditions (FWOP) and future-with project conditions (FWP) to a projected baseline condition. This "baseline projection" was performed for the various affected habitats and was based on observed habitat changes in the active delta between 1956 and 1978 (Wicker, 1980). These habitat change trends were then projected through the year 2042. The FWOP and FWP impacts on these same habitats were then compared to the "baseline projection." This methodology was adopted because the conventional FWOP and FWP comparisons would not have been appropriate. With or without the recommended project, significant acreages of marsh are projected to be created as a result of the continued use of existing maintenance procedures for the 40-foot navigational channel. Up to the present, marsh creation, as a result of these maintenance procedures, has been accomplished on a discretionary basis, i.e., without requirements or commitments to do so. This same discretionary condition would persist under without project conditions. Under with project conditions, however, a minimum of 9,000 acres of marsh has been assured. Therefore, with-project marsh creation, resulting from continued use of existing maintenance procedures, would no longer be discretionary in nature. This difference in the nature of marsh creation has been judged to make a direct comparison of future-with and future-without project conditions inappropriate for the purposes of assessing the need for fish and wildlife mitigation. Under these circumstances the "baseline projection" would serve as a more appropriate future against which to compare FWOP and FWP, because it is based on a period (1956 to 1978) when relatively little marsh was created by the disposal of dredged material.

4.3.2. As displayed in Table 4.3.1., the minimum and maximum Average Annual Habitat Units (AAHU) correspond to minimum and maximum marsh creation acreages. These marsh creation acreages were developed as described in Section 4.1.8., "Maintenance Procedures." The use of

TABLE 4.3.1.

CHANGES IN AVERAGE ANNUAL HABITAT UNITS (AAHU) FOR EVALUATION SPECIES UNDER FUTURE-WITHOUT PROJECT CONDITIONS (FWOP) AND FUTURE-WITH PROJECT CONDITIONS (FWP)[1/]

| Evaluation Species | Baseline Projection AAHU | FWOP AAHU | FWOP Change | FWP AAHU | FWP Change |
|---|---|---|---|---|---|
| Dabbling Ducks | 35,806 | 36,095<br>(35,807) | 289<br>(1) | 36,836<br>(36,559) | 1,030<br>(753) |
| Alligators | 21,505 | 23,773<br>(23,845) | 2,268<br>(2,340) | 21,514<br>(21,583) | 9<br>(78) |
| Nutria | 23,817 | 29,514<br>(28,724) | 5,697<br>(4,907) | 25,810<br>(25,049) | 1,993<br>(1,232) |
| Rabbits | 17,871 | 23,523<br>(22,949) | 5,652<br>(5,078) | 20,130<br>(19,576) | 2,259<br>(1,705) |
| Herons & Egrets | 28,910 | 31,442<br>(30,796) | 2,532<br>(1,886) | 30,843<br>(30,220) | 1,933<br>(1,310) |
| Terns & Skimmers | 46,216 | 38,730<br>(39,664) | -7,486<br>(-6,552) | 43,878<br>(44,778) | -2,338<br>(-1,438) |
| White-tailed Deer | 13,969 | 18,224<br>(17,793) | 4,255<br>(3,824) | 15,485<br>(15,070) | 1,516<br>(1,101) |

1/ The values in parentheses are based on a minimum projected marsh creation acreage.

these minimum and maximum marsh creation acreage values served to test how sensitive the results of the HEP analysis were to estimates of the quantity of marsh to be created. The only evaluation species displaying a decrease in AAHU was terns and skimmers. They declined by between 6,552 and 7,486 AAHU under FWOP and by between 1,438 and 2,338 AAHU under FWP. This decrease was a result of a decrease in the acreage of estuarine water bodies associated with the creation of marsh. It should be noted, however, that this decrease would be more than offset by an increase of estuarine water bodies within the active delta as a whole, as discussed in Section 6.14., "Estuarine Water Bodies."

4.3.3. Based on the HEP analysis, there would be no direct compensation acreage required to offset losses to terns and skimmers. The HEP "in-kind" replacement goal, which would normally require compensation for all negatively impacted evaluation species, has not been applied in this case. The reason is that estuarine water bodies, which are classified as Resource Category 3 (U. S. Fish and Wildlife Service, 1981) for this project, are being displaced by marsh. This marsh, considered Resource Category 2 for this project, is a more valuable habitat to all evaluation species. A mitigation goal for Resource Category 3 is the minimization of losses. This goal would be achieved, with the recommended project, by the creation of marsh as a result of the unconfined disposal of hydraulically dredged shoal material. In addition, the creation of scrub/shrub habitat associated with the bank nourishment feature would offer some limited potential for nesting of terns and skimmers. Care would be taken in project disposal areas to avoid disturbance of nesting colonies during the maintenance of bank nourishment and annual inventories of nesting colonies.

4.3.4. The other method used to quantify the impacts of the project was a man-day analysis. Table 4.3.2. displays changes in average annual man-day values for each recreational activity under FWOP and FWP. This man-day analysis reveals that increases in man-day values would occur

TABLE 4.3.2.

CHANGES IN AVERAGE ANNUAL MAN-DAY (AAMD) VALUES BY RECREATIONAL ACTIVITY UNDER FUTURE-WITHOUT PROJECT CONDITIONS (FWOP) AND FUTURE-WITH PROJECT CONDITIONS (FWP)1/

| Recreational Activities | Baseline Projection AAMD | FWOP AAMD | FWOP Change | FWP AAMD | FWP Change |
|---|---|---|---|---|---|
| Big Game Hunting | 17,095 | 23,874 | +6,779 | 18,680 | +1,585 |
| Small Game Hunting | 6,649 | 9,462 | +2,813 | 7,561 | +912 |
| Waterfowl Hunting | 9,333 | 14,292 | +4,959 | 11,419 | +2,086 |
| Freshwater Sport Finfishing | 533,408 | 846,169 | +312,761 | 610,936 | +77,528 |
| Saltwater Sport Finfishing | 99,425 | 148,763 | +49,338 | 126,569 | +27,144 |
| Sport Crabbing | 106,307 | 159,059 | +52,752 | 135,330 | +29,023 |
| Sport Shrimping | 6,644 | 9,941 | +3,297 | 8,458 | +3,297 |
| Total AAMD | 778,861 | 1,211,560 | 432,699 | 918,953 | 141,575 |
| (Rounded) | 779,000 | 1,212,000 | 433,000 | 919,000 | 142,000 |

1/ See Appendix D, "Recreational Resources" for additional information.

for all recreational activites under FWOP and FWP. The man-day analysis was based on the maximum marsh creation figures discussed earlier. In view of the results of the HEP analysis, which tested the effects of using both the maximum and minimum marsh creation figures, it was decided that it would not be necessary to use the minimum marsh creation acreages in the man-day analysis.

4.3.5. Based on both the HEP and man-day analyses, there would be no mitigation requirement resulting from construction and maintenance of the recommended project.

TABLE 4.4. COMPARATIVE IMPACTS

This table briefly displays the base conditions (1985) for each of the significant resources described in Section 5.0., "Affected Environment," and compares impacts to these significant resources under both without project and with project conditions. A more detailed discussion of impacts is contained in Section 6.0., "Environmental Effects." For the purpose of assessing project impacts to biological significant resources, the project area is the active delta of the Mississippi River, as displayed on Plate 1. When discussing project impacts to socioeconomic significant resources, the term "project area" is broadened to also include the various parishes bordering the Mississippi River between Baton Rouge, Louisiana, and the Gulf of Mexico. It should be noted that the impacts discussed in this table and Section 6.0. are those associated with the 40-foot navigational channel. Under future-without project conditions, these impacts result from dredging and disposal of dredged material, while under future-with project conditions they result from both dredging and disposal and construction and maintenance of the project features. One of the issues discussed in Section 4.2., "Without Project Conditions," concerns the future impacts of subsidence and erosion within the active delta. These impacts would be expected to occur under with or without project conditions and, therefore, although identified in Section 4.2., are not included in the impact discussions.

TABLE 4.4.

## COMPARATIVE IMPACTS

COMPARATIVE IMPACTS

| SIGNIFICANT RESOURCES | CONDITIONS | | |
|---|---|---|---|
| | Base Conditions | Without Project Conditions | With Project Conditions |
| Air Quality | The project area is considered Class II for Prevention of Significant Deterioration purposes under the Clean Air Act. Breton Island National Wildlife Refuge is considered Class I and is the only such area in the State of Louisiana. | Dredging activity and associated exhaust emissions would increase, but this increase should not cause significant deterioration of existing Class II Air Quality. | Increased exhaust emissions, associated with project construction, should not cause significant deterioration of existing Class II Air Quality. A reduction of maintenance dredging [illegible] enhance air quality slightly. Because Breton Island National Refuge is over [illegible] miles from construction and maintenance activities, no impacts would be expected. |
| Audubon Society 'Blue List' Species | The ranges of 27 of the total 30 'Blue List' species include, or are likely to include, the project area. | Creation of marsh and scrub/shrub uplands should benefit most of the species. Loss of natural levee forest would accelerate the movement of migrant arboreal [illegible] through the project area. | Impacts would be similar to those described for without project conditions. Benefits to the [illegible] would [illegible] because fewer acres of marsh and [illegible] would be created. The loss of natural levee forest would be slightly accelerated. |
| Business and Industrial Activity | Since World War II, the growth of the New Orleans-Baton Rouge River Region has been based largely on port activities, ship building, and mineral production and processing. In recent years, tourism and related construction have also been important factors in the area's continued expansion. | With continued deterioration of the channel conditions, shipping interests would be forced to alter their methods of operations, including the diversion of traffic to other ports. A major restructuring of the project area's economic base would result with the decline in port activities. Satellite and service industries would be seriously affected. | The continued maintenance of a [illegible] channel depth in the Mississippi River would facilitate the continued growth of New Orleans, Baton Rouge, and the river region as a whole. |
| Community Cohesion | Maintenance of a 40-foot channel in the Mississippi River, from Baton Rouge to the Gulf, has been strongly supported by the residents and elected officials of the project area for many years. The employment and income created by the ports and related transportation activities have been important factors binding the several interests of the local communities. | Over the long term, community cohesion would suffer because of outmigrations of industries, employment, and lower incomes. | Implementation of the project features would allow for the orderly development of port and port-related activities, which, in turn, provide major contributions towards community well being. Present levels of community cohesion would be maintained. |
| Community Growth | The river region has a long history of sustained economic development. An abundance of natural resources and a mild climate have been the primary motivating factors. New Orleans and Baton Rouge are the principal centers; total population exceeds 1.7 million. | With a decline in waterway traffic, communities along the river which depend on port activities for employment and income would experience stagnation or contraction over an extended period of time. | Continued growth of waterborne commerce would facilitate the expansion of related economic activities and community developments. |
| Delta National Wildlife Refuge | This 48,000-acre refuge is located within the project area. Its extensive areas of marsh and estuarine water bodies make it valuable as a wintering area for waterfowl. | Freshwater flow to the refuge would increase as the Mississippi River bank subsides. The use of dredged material to create marsh and scrub-shrub uplands adjacent to the refuge would be beneficial. | The preservation of the existing freshwater outlets and increased flow through [illegible] coupled with creation of [illegible] acres of adjacent marsh, would benefit the refuge. |
| Displacement of Farms | Midwestern grains comprise a significant portion of the exports moving over the waterway. The 40-foot channel helps United States farmers be competitive in world grain markets by providing economical transportation. | With reduced channel depths, grain movements would be performed in a more costly manner. Less efficient farms would be removed from production or consolidated because of higher costs. | Maintaining the channel at a sufficient depth would facilitate the continued flow of agricultural commodities. No farmland would be [illegible] |
| Displacement of People | The population of the project area has experienced continued growth as employment opportunities have increased. Increased employment stems primarily from expansion of mineral production and processing, tourism, construction, and port activities along the waterway. | With requirements to reduce vessel drafts, related transportation activities would eventually decline, diverting traffic and employment opportunities. This would have a corresponding impact on the project area's population, including substantial outmigration. | Maintaining the channel would facilitate normal income growth and employment and would help maintain the stability of the local population. |
| Employment Labor Force | In May of 1983, civilian employment in the Baton Rouge and New Orleans Standard Metropolitan Statistical Areas, and in the other five parishes through which the Mississippi River passes on its way to the gulf, totaled about 727,000. Unemployment was approximately [illegible] percent. | Because of increasing channel restrictions, port activities would gradually be reduced. Employment opportunities would be adversely impacted. Outmigration of part of the labor force would follow. | Maintenance of the channel at the authorized dimensions would [illegible] continued growth of [illegible] |
| Endangered/Threatened Species | The endangered Kemp's ridley sea turtle and the threatened green and loggerhead sea turtles are the three species of concern within the project area. | The creation of marsh would increase food supplies for these species, however, bio-accumulation potential would also result from the creation of extensive marsh areas. | The creation of marsh would increase food supplies. There would also be [illegible] potential for bio[illegible] |

## TABLE 4.4. (cont'd)

## COMPARATIVE IMPACTS

| SIGNIFICANT RESOURCES | CONDITIONS | | |
|---|---|---|---|
| | Base Conditions | Without Project Conditions | With Project Conditions |
| ENERGY | The lower reach of the river, with its deep-draft capabilities, provides an energy-efficient means of transporting large volumes of grain, petroleum, minerals petro-chemicals, ores, and processed metals. | If the project waterway could not be maintained at sufficient channel depths, a large portion of these commodity movements would have to be accomplished by less energy efficient means. | Maintaining the channel at sufficient depths would facilitate the continued energy efficient movement of these vital resources. |
| ESTHETIC VALUES | Esthetic values within the active delta include a unique blend of wetlands, natural levee forests, estuarine water bodies, and winding bayous. Historic areas such as the Vieux Carre in New Orleans and plantations along the Mississippi River are characteristic of the region. | Pressures for additional urbanization industrialization would be reduced, lessening the need for converting farms, woodlands, and wetlands to development. | Continued normal economic growth would require the conversion of additional undeveloped areas for urban and industrial purposes. Such development would probably occur upriver and not within the active delta. Conversely, urban improvements incorporating attractive art forms and interesting abstract figures might afford new opportunities for human appreciation. The presence of rock foreshore dikes would drastically change the visual esthetics of the river banks. |
| ESTUARINE WATER BODIES | Subsidence, erosion, and oil/gas industry activities are resulting in an increase of this habitat type. There are 277,700 acres of estuarine water bodies within the project area. | The creation of marsh and scrub/shrub uplands would result in a maximum 42,400-acre loss of estuarine water bodies by year 2042. | The creation of marsh would result in a maximum 13,600-acre loss of estuarine water bodies by year 2042. |
| FISHERIES | The Mississippi River and its tributaries, dredged canals, marshes, and estuarine water bodies provide habitat for a variety of fresh and saltwater aquatic species of commercial and recreational importance. | The creation of between 23,000 and 28,400 acres of marsh would benefit fisheries by providing feeding and nursery habitat. The potential exists, however, for bioaccumulation of contaminants from created marshes. | The creation of between 9,000 and 13,600 acres of marsh would benefit fisheries, although not to the extent under without project conditions, because of the smaller quantity created. The potential for bioaccumulation of contaminants would exist. Freshwater outlets would be provided to supply river flows to areas presently receiving such flows, thus nourishing created marshes and countering saltwater intrusion. |
| INCOME | Per Capita personal income levels in the river region vary from above the national average in the overall metropolitan areas of New Orleans and Baton Rouge to somewhat below average in the adjacent, more rural areas. | Because a substantial portion of regional income is port related, any long-term loss of river traffic would have negative impacts on overall income levels. | Income derived from port and port-related activities would increase with unconstrained projected growth in commodity movements. |
| MARSH | The project area contains 54,000 acres of marsh, of which 32,000 acres is fresh and 22,000 acres is nonfresh. | Hydraulic dredging and overbank disposal of shoal material would result in the creation of between 23,000 and 28,400 total acres of marsh by the year 2040. Of these totals, fresh would comprise 17,700 acres and nonfresh would comprise between 5,300 and 10,700. Mississippi River overbank flows would not be expected to result in natural marsh accretion. | Hydraulic dredging and overbank disposal of shoal material would result in the creation of between 9,000 and 13,600 total acres of marsh by the year 2042. Of these totals, fresh marsh would comprise 900 acres while nonfresh marsh would comprise between 8,100 and 12,700 acres. |
| MISSISSIPPI RIVER/ NAVIGATION | The ports of New Orleans and Baton Rouge are among the most important seaports in the world. Their vitality depends, to a large extent, on the availability of a 40-foot channel in the river. An annual average of 20 million cubic yards of shoal material is dredged from the 30-mile-long navigational channel within the project area. This amount of dredging has resulted in 40-foot and 38-foot channel depths 70 percent and 87 percent of the time, respectively (Refer to EIS Figure 4.2.1.). | A project depth of 40 feet would be unattainable for an increasingly longer period of time because of channel instability (Refer to EIS Figure 4.2.1.). Eventually an equilibrium point would be reached where 54.2 million cubic yards of shoal material a year would be dredged. This shoaling increase would be a result of bank subsidence. This amount of dredging would maintain 40-foot and 38-foot channel depths 10 percent and 50 percent of the time, respectively. Large navigational losses would result because of reduced channel depths. | The recommended project would more effectively maintain the existing channel depth at 40 feet, assuring the efficient use of port facilities on the river. An annual average of 12.7 million cubic yards of shoal material would be dredged. As displayed on Figure 4.2.1., this amount of dredging would maintain 40-foot and 38-foot channel depths 90 percent and 9[illegible] percent of the time, respectively. Shipping cost would be minimized. Over the project life, average annual transportation savings of $962,230,000 would be realized. Construction of project features (including lateral pile dikes) would eliminate 3,000 acres of river and cause temporary impacts to another 1,000 acres. |
| NATIONAL REGISTER OF HISTORIC PLACES | No properties listed on the National Register of Historic Places (Register) are present within the active delta; however, a number of significant identified cultural sites are within the delta. Some of these sites, such as Burrwood, are potentially eligible for inclusion on the Register. | Subsidence and erosion would significantly degrade standing and buried cultural sites within the active delta. Submerged sites would be essentially unaffected. | No known cultural resource sites would be impacted by project construction. The foreshore dike in the vicinity of the Burrwood site would be aligned and constructed to avoid destruction of standing and submerged cultural features associated with the site. |
| NATURAL LEVEE FOREST | There are 950 acres of natural levee forest in the project area. | All natural levee forest would be eliminated from the project area by the year 1990, because of subsidence and erosion. | The construction of the bank nourishment feature would eliminate 270 acres of natural levee forest between 1985 and 1987. This would result in the elimination of all project-area natural levee forest by 1989. Periodic maintenance of the bank nourishment would prevent the development of new forested areas. |

## TABLE 4.4. (cont'd)

## COMPARATIVE IMPACTS

| SIGNIFICANT RESOURCES | CONDITIONS | | |
|---|---|---|---|
| | Base Conditions | Without Project Conditions | With Project Conditions |
| NESTING COLONIES | There are six active seabird and wading bird nesting colonies, comprised of 2,700 to 12,100 adult birds, within the project area. In addition, there are three Least Tern colonies. | The creation of 14,000 acres of scrub/-shrub uplands should provide extensive areas of nesting habitat for seabirds and wading birds. Extensive dredged material disposal activities along Southwest Pass would probably cause the relocation of all existing colonies along Southwest Pass to new areas along Southwest Pass. | The creation of 2,100 acres of scrub/shrub uplands associated with the bank nourishment would offer limited nesting potential. Dredged-material disposal that emphasizes marsh creation, would result in the displacement of the existing colonies and a reduction of nesting habitat within the project area over what would be expected under without project conditions. |
| NOISE | Navigational vessels and channel maintenance activities are the primary sources of human-related noise within the active delta. The areal extent of the project area, coupled with the confinement of most human-related noise to the navigational channel, has allowed wildlife to coexist with current noise levels. The scant human population of the active delta is conditioned to existing noise levels. | Increased dredging activities would increase the level and duration of noise within the active delta. This increase, however, would not significantly affect human or wildlife populations within the active delta. | Increased noise levels associated with construction would be local and relatively short term. Reduced dredging activities should reduce noise levels within the active delta. |
| PASS A LOUTRE WATERFOWL MANAGEMENT AREA | This 66,000-acre area is administered by the State of Louisiana. Its extensive marshes and estuarine water bodies support trapping, waterfowl and rabbit hunting, and sport and commercial fishing. | No dredged-material marsh would be created within the management area. | A slight increase of freshwater flows, with accompanying sediment, would prevent saltwater intrusion and enhance sediment management efforts by the State of Louisiana. |
| PLAN ECONOMICS | N/A | 0 | (see Plan Economics detail below) |
| PROPERTY VALUES | Property values in the project area are increasing as urban and industrial development expand. | If the navigational channel cannot be maintained at project depths sufficient for traffic at current and future levels, the value of port and ancillary facilities along the river would decline as a result of the reduced utilization. Property values would suffer. | Effectively maintaining the waterway would encourage continued economic growth in the project area and assist in assuring stable property values. |
| PUBLIC FACILITIES AND SERVICES | Because port and port-related activities comprise a large part of the regional economic output, they play a major role in providing support for public facilities and services. | If the navigational channel was not maintained to 40 feet, and oceangoing vessels were restricted in reaching the Ports of New Orleans and Baton Rouge, there would be substantial reductions in the need for public facilities and services used in accommodating those movements. | Maintenance of the project waterway to the authorized depth would help support the economic base of the project area and thereby help to generate revenues sufficient to maintain necessary public facilities and services. |
| RECREATION | Fishing, hunting, and boating are major recreational activities in the active delta. Recreational use of the Mississippi River is limited. Baseline projected average annual use is $779,000 man-days valued at $4,386,000. | Recreational demands on public lands would increase. Average annual recreational usage would be 1,212,000 man-days, a gain of 433,000 over the "baseline projection." This 433,000 man-day increase translates into an average annual recreational value of $1,431,000. | Average annual recreational usage would be 919,000 man-days, a gain of 142,000 over the "baseline projection." This 142,000 man-day increase translates into $630,000 average annual benefits. The net effect of the foreshore dikes on Mississippi River shoreline access should be insignificant. |
| REGIONAL GROWTH | Port and port-related activities have been significant factors in the project area's growth. The New Orleans-Baton Rouge regional area has long been a major world-trade center. | Any decline in port activities, that would result from reduced channel depths, would seriously impact future growth in the river region. Outmigrations of some existing developments would occur. | Full maintenance of the navigational channel would facilitate an extension of current economic activity, resulting in continued regional growth. |

PLAN ECONOMICS — With Project Conditions:

| | Project Interest Rate | Current Interest Rate |
|---|---|---|
| **Average Annual Costs:** | | |
| Interest | $8,640,000 | $26,730,000 |
| Amortization (50 years) | $3,255,000 | $549,000 |
| Operation and Maintenance | $24,678,000 | $26,471,000 |
| Total | $36,573,000 | $53,750,000 |
| **Average Annual Benefits:** | | |
| Navigation | $942,230,000 | $672,220,000 |
| Maintenance Dredging Savings | $55,448,000 | $45,111,000 |
| Recreation | $630,000 | $414,000 |
| Total | $998,308,000 | $717,772,000 |
| Benefit/Cost Ratio: | 27.3 | 13.4 |
| Interest Rate Used: | 2 5/8% | 8 1/8% |
| Total First Costs: | | $341,000,000 |

## TABLE 4.4. (cont'd)

## COMPARATIVE IMPACTS

| SIGNIFICANT RESOURCES | CONDITIONS | | |
|---|---|---|---|
| | Base Conditions | Without Project Conditions | With Project Conditions |
| SCRUB/SHRUB UPLANDS | There are approximately 10,000 acres of scrub/shrub uplands in the project area. | Future hydraulic dredging and overbank disposal of shoal material would result in the creation of 14,000 acres of scrub/-shrub uplands by the year 2042. | The construction of the bank nourishment feature would result in the creation of 2,100 acres of scrub/shrub uplands by 1992 with continued maintenance through 2042. Approximately 3,600 acres of existing up-lands would subside, by the year 2006, to marsh and be maintained through the year 2042. |
| TAX REVENUES | The tax base of the project area is substantially dependent upon income generated, either directly or indirectly, by port and port-associated activities located along the project waterway. | Because of the regional economy's consid-erable dependence on port functions, declines caused by a lack of adequate channel depths would have a significant adverse impact on the area's tax base, particularly in the vicinity of New Orleans. | The recommended project would help main-tain the economic vitality of the project area which, in turn, would help generate tax revenues. |
| WATER QUALITY | | | |
| Flow Distribution | Percent of river flow discharged by each major distributary, outlet, and overbank low area is known for each month. This information is displayed in Table 6 of Appendix E, "Water Quality." | Overbank flows would increase as banks continue to subside and erode. Distributary flows would decrease resulting in significant shoaling of the navigational channel. | Increased distributary flows during high discharge periods would add water to the overbank, while closure of outlets and control of overbank sheet flow would reduce flows. A month by month breakdown by distributary and overbank area appears in Table 6 of Appendix E, "Water Quality." |
| Circulation | East: River water influence gradually decreasing in the east delta because of subsidence which allows increased *saltwater intrusion*. | East: Increasing gulf influence | East: Small increase in river water influence in the east delta marshes, and Mississippi and Breton Sounds, decreases on the east side of East Bay. |
| | West: Large overbank flows in all, but low-flow months. Very little saltwater in the marshes except *along* Southwest Pass. | West: Continuing trend of large overbank flows, little gulf influence, and increasing erosion. | West: Much less river influence Above Head of Passes in west delta marshes. Little change in river influence along *west side of Southwest Pass*. |
| Salinity | Salinities within the active delta are influenced by river discharge, winds, and tides. | East: Increasing salinities as riverbanks erode, subsidence continues and resulting river stages decline. | East: Slight decrease in salinities during low flows, particularly at the surface in the east delta marshes Above Head of Passes. An increase in salinities along the east side of Southwest Pass. |
| | | West: Overbank areas Above Head of Passes would *remain fresh at all discharges and* areas along west Southwest Pass could become fresher. | West: Localized increases of salinity in *the* west delta marshes Above Head of Passes during low flow. No change in the marshes during high flow. |
| Dissolved Oxygen | Annual average range of 5.0-12.0 mg/l. | No significant change; levels would remain in 5.0-12.0 mg/l range. | No significant change; levels would remain in 5.0-12.0 mg/l range. |
| Nutrients | Nutrients are not limiting factors for growth of vegetation. Ambient levels *sustain all marsh areas where the* substrate is at an elevation conducive to marsh plant growth. | Nutrients would continue to be plentiful throughout the active delta. | Nutrients would continue to be plentiful throughout the delta. Newly created marshes would have high nutrient quantities which would promote lush growth of marsh plants. |
| Contaminants | Ambient levels of certain toxic metals and organics present a limited risk of acute and chronic impacts to aquatic animals. The potential for bioaccumulation and magnification, through the food web, also exists. Most of these contaminants, however, are not located in areas of high biological activity like marshes. | Ambient levels would not change significantly. Marsh creation would continue in most areas as a result of unconfined disposal of dredged material. Elevated contaminant levels in the interstitial water of created marshes could occur, but would eventually be diluted to ambient. Uncontrolled building of scrub/shrub uplands might produce oxidized sediments which would mobilize contaminants into adjacent lower elevations. Contaminants released into the river and pass would be diluted immediately, but increased levels could be experienced in the marshes. | Ambient levels would not be affected. Oxidation of contaminants in the bank nourishment feature would cause release into the river and pass where they would be immediately diluted. Contaminants added to the overbank areas as a result of marsh creation could elevate levels in the interstitial water; however, eventual flushing of the marshes by tidal or river flows would dilute these levels back to ambient. *The potential for* bioaccumulation would exist, however. |
| WILDLIFE | The project area, with its diverse habitats, is populated by a variety of mammals, birds, reptiles, and amphibians. | The creation of between 23,000 and 28,400 acres of marsh and 14,000 acres of scrub/shrub uplands would benefit wildlife *within the project area. The potential* exists, however, for bioaccumulation of contaminants. | The creation of between 9,000 and 13,600 acres of marsh and 2,100 acres of scrub/shrub uplands would benefit *wildlife. The potential for* bioaccumulation would remain. |

## 5.0. AFFECTED ENVIRONMENT

### 5.1. ENVIRONMENTAL CONDITIONS

5.1.1. For the purpose of assessing project impacts to biological significant resources, the project area is the active delta of the Mississippi River which corresponds to Wicker's (1980) Hydrologic Unit 3. When discussing project impacts to the socioeconomic significant resources, the term "project area" also includes the parishes listed in Paragraph 5.1.5. The delta is sparsely populated and characterized by large expanses of marsh and estuarine water bodies. Small areas of natural levee forest and scrub/shrub uplands are located along the river and its major passes. Water level fluctuations within the marshes, river, passes, and estuarine water bodies result from the influence of tides and/or winds. Because of its proximity to the Gulf of Mexico, the project area has a subtropical marine climate.

5.1.2. Important animals in the delta include mammalian furbearers such as nutria, muskrat, mink, raccoon, and otter. The American alligator also is harvested for its hide and meat in portions of the delta. White-tailed deer, rabbits, various species of small mammals, passerine birds, raptors, reptiles, and amphibians, also are present. Large populations of migratory waterfowl, wading birds, shorebirds, seabirds, and waterbirds use the marshes, natural levee forests, and estuarine water bodies. The marshes and estuarine water bodies, by virtue of their functioning as spawning and/or nursery areas, provide the basis for a good sport and commercial fishery for finfish and shellfish. Fishing, hunting, boating, camping, and picnicking are popular recreational activities in the delta.

5.1.3. Extensive dredging is performed annually within the delta to maintain navigation to New Orleans and Baton Rouge, Louisiana. These ports rank first and sixth, respectively, in the United States, based on

volume and value of commerce. Major commodities moving on the Mississippi River through the delta to these ports include grains, coal, petroleum products, non-metallic minerals, gravel, salt, sulphur, and many chemicals. Traffic through the delta consists primarily of oceangoing ships and various types of barges.

5.1.4. No National Register of Historic Places (NRHP) sites presently exist within the delta. Numerous cultural resources sites are present, however, and some of these potentially could be eligible for inclusion into the NRHP.

5.1.5. The socioeconomic data in this EIS are based on parishes within the Baton Rouge and New Orleans Standard Metropolitan Statistical Areas (SMSA) and the non-SMSA parishes through which the river passes from Baton Rouge to the Gulf: Baton Rouge SMSA (East Baton Rouge, West Baton Rouge, Ascension, and Livingston Parishes); Non-SMSA Parishes (Iberville, Plaquemines, St. James, St. John the Baptist, and St. Charles Parishes); New Orleans SMSA (Jefferson, Orleans, St. Bernard, and St. Tammany Parishes).

## 5.2. SIGNIFICANT RESOURCES

### 5.2.1. General.

Each significant resource included in Table 4.4., "Comparative Impacts," is discussed in this section. A given resource is designated as significant because: it is identified in the laws, regulations, guidelines or other institutional standards of national, regional, and local agencies; it is specifically identified as a concern by local public interests; or it is judged by the responsible Federal agency to be of sufficient importance to be so designated. Several resources have been identified for consideration based on identification of their

significance in Section 122 of the 1970 River and Harbor Act (PL 91-611).

5.2.2. Air Quality.

The project area is classified as Class II for the Prevention of Significant Deterioration purposes, as defined in the Clean Air Act. The Breton National Wildlife Refuge, the only Class I area in Louisiana, is approximately 15 miles from project construction areas at the nearest point.

5.2.3. Audubon Society "Blue List" Species.

The "Blue List," published by the National Audubon Society in "American Birds" magazine, cites bird species that are showing indications of non-cyclical population decline or range contraction, either locally or throughout their range. This list, compiled by interested observers throughout the country, serves as an early warning system to indicate those species that might be in danger of extinction in the future. The 1982 "Blue List" identifies 30 species. The ranges of 27 of those species include, or are likely to include, the project area and are listed below.

Western Grebe
Least Bittern
American Bittern
Sharp-shinned Hawk
Red-shouldered Hawk
Swainson's Hawk
Marsh Hawk
King Rail
Piping Plover
Snowy Plover
Short-eared Owl
Ruby-throated Hummingbird
Hairy Woodpecker
Willow Flycatcher
Bewick's Wren
Eastern Bluebird
Loggerhead Shrike
Bell's Vireo
Golden-winged Warbler
Yellow Warbler

Long-billed Curlew
Upland Sandpiper
Least Tern
Black Tern
Eastern Meadowlark
Dickcissel
Grasshopper Sparrow

### 5.2.4. Business and Industrial Activity

Port operations and port-related activities, mineral production and processing, shipbuilding, tourism, and associated construction form the primary economic base of the project area. Table 5.2.1. illustrates business and manufacturing trends, as reported by the Bureau of the Census. The unusually high value added by manufacture and volume of wholesale trade, relative to the population of the project area, reflects the high value of the minerals processed and products manufactured in the area and the significance of the Port of New Orleans as a major regional market. The retail trade data indicate growth in the average size of establishments and increased productivity. Also, the high volume of service receipts reflect the importance of tourism to the local economy.

### 5.2.5. Community Cohesion

Maintenance of a deep-draft channel on the Mississippi River, from Baton Rouge to the Gulf of Mexico, has received widespread support from officials of other states, as well as the elected representatives of the project area for many years. The employment and income created by the ports and related transportation activities have been important factors binding the general interests of the local communities in the river region. Because the sale of midwestern grain is directly impacted by transportation costs, the farmers and officials in that part of the country also are vitally concerned with channel conditions on the lower river.

TABLE 5.2.1.

BUSINESS AND MANUFACTURING TRENDS

| AREA | 1954 No. of Establishments | 1954 Sales/Receipts for Value Added by Manufacturer ($1,000's) | 1954 No. of Employees | 1967 No. of Establishments | 1967 Sales/Receipt for Value Added by Manufacturer ($1,000's) | 1967 No. of Employees | 1977 No. of Establishments | 1977 Sales/Receipt for Value Added by Manufacturer ($1,000's) | 1977 No. of Employees |
|---|---|---|---|---|---|---|---|---|---|
| **Wholesale Trade** | | | | | | | | | |
| Baton Rouge SMSA | 220 | 125,967* | 2,312* | 520 | 546,158* | 5,638* | 752 | 2,889,670 | 9,566 |
| Non-SMSA Parishes | 67 | 19,271 | 372* | 95 | 157,924 | 1,064 | 151 | 340,968 | 1,649 |
| New Orleans SMSA | 1,470 | 1,757,569 | 20,701 | 1,918 | 3,514,299 | 27,083 | 2,226 | 8,987,568 | 31,274 |
| Total Project Area | 1,757 | 1,902,807* | 23,385 | 2,533 | 4,218,381* | 33,785* | 3,129 | 12,218,206 | 42,489 |
| % of State Total | 48.3 | 65.1* | 57.8* | 48.3* | 63.5* | 58.7* | 46.0 | 62.5 | 52.3 |
| **Retail Trade** | | | | | | | | | |
| Baton Rouge SMSA | 2,032 | 229,015 | 11,455 | 2,564 | 558,929 | 16,328 | 3,257 | 1,604,631 | 27,638 |
| Non-SMSA Parishes | 821 | 44,585 | 1,512 | 966 | 97,522 | 2,410 | 1,028 | 282,345 | 5,031 |
| New Orleans SMSA | 7,547 | 781,594 | 41,137 | 7,778 | 1,574,837 | 53,496 | 8,278 | 3,926,459 | 74,912 |
| Total Project Area | 10,400 | 1,055,194 | 54,104 | 11,308 | 2,231,288 | 72,234 | 12,563 | 5,813,435 | 107,581 |
| % of State Total | 38.7 | 45.1 | 50.2 | 37.0 | 46.9 | 49.7 | 39.2 | 46.8 | 49.1 |
| **Services** | | | | | | | | | |
| Baton Rouge SMSA | 785 | 19,402 | 2,957* | 1,764 | 70,087 | 5,666 | 3,303 | 375,296 | 15,450 |
| Non-SMSA Parishes | 204 | 2,526 | 229 | 468 | 17,465 | 1,200 | 687 | 69,774 | 2,519 |
| New Orleans SMSA | 3,587 | 146,904 | 16,151 | 5,836 | 322,362 | 28,351 | 9,013 | 1,270,800 | 50,697 |
| Total Project Area | 4,576 | 168,832 | 19,337 | 8,068 | 409,914 | 35,217 | 13,003 | 1,715,870 | 68,666 |
| % of State Total | 45.7 | 61.1 | 58.4 | 44.4 | 59.6 | 63.2 | 47.2 | 58.3 | 63.2 |
| **Manufacturers** | | | | | | | | | |
| Baton Rouge SMSA | 211 | 259,246 | 20,035 | 282 | 539,500 | 18,700 | 407 | 2,075,500 | 24,100 |
| Non-SMSA Parishes | 63 | 33,594* | 4,967 | 93 | 211,900* | 5,900* | 145 | 2,033,400 | 15,800 |
| New Orleans SMSA | 899 | 378,685 | 54,219 | 906 | 860,100 | 55,500 | 1,031 | 1,577,400 | 46,800 |
| Total Project Area | 1,173 | 671,525* | 79,221 | 1,281 | 1,611,500 | 80,100 | 1,583 | 5,686,300 | 86,700 |
| % of State Total | 38.8 | 56.8* | 54.7 | 35.2 | 57.8* | 48.7* | 37.0 | 60.4 | 44.5 |

* Figures do not include data withheld to avoid disclosure of confidential records.

Sources: U. S. Bureau of the Census (1960a; 1960b; 1960c; 1961a; 1969a; 1969b; 1969c; 1970; 1979; 1980a; 1980b; 1980c)

5.2.6. Community Growth

Communities in the project area have grown as employment opportunities have developed in shipping and foreign trade, mineral and related chemical industries, tourism, and construction. An abundance of natural resources, including the large, dependable flow in the Mississippi River, and a temperate climate have provided strong inducements for urban and industrial development. Present population in the project area exceeds 1.7 million, most of which is in the New Orleans and Baton Rouge metro areas. Over the past few decades, population growth in the river region has exceeded the national average.

5.2.7. Delta National Wildlife Refuge

This 48,000-acre national wildlife refuge is located on the east bank of the Mississippi River, bordered on the north by Baptiste Collette Bayou, and on the south by Pass a Loutre (see Plate 1). The refuge serves as a major protected wintering area for migratory waterfowl. Commercial fishing, trapping, rabbit hunting, and various public recreational activities account for other uses of this refuge. From 1967 through 1977, an 11-year annual average of 190,812 pounds of catfish and gar, worth $36,159 annually, were caught by commercial fisherman. During this same time, an annual average of 11 nutria trapping permits were issued and an annual average of 6,186 nutria worth $31,549 were trapped. During the 1981-82 winter, the refuge supported a peak population of approximately 125,000 ducks, geese, and coots. In 1981, over 200,000 pounds of freshwater fishes were commercially harvested on the refuge with an estimated value of $90,000. Six commercial trappers harvested over 1,900 nutria during the 1981-82 trapping season (U. S. Fish and Wildlife Service, 1982). Public recreational use from 1970 through 1979 amounted to an annual average of 2,953 man-days of sportfishing and 102 man-days of wildlife observation. A 6-year annual average of 83 group-picnicking events occurred from 1974 to 1979.

5.2.8. Displacement of Farms

Farm produce comprises a significant portion of the exports moving over the waterway. Because the United States is the world's leading supplier of foodstuffs, the economical transportation of these goods is paramount to maintaining a strong export position. In 1981, some 60.3 million tons, or nearly 80 percent of the total exports passing through New Orleans, consisted of grains mostly originating in the midwest.

5.2.9. Displacement of People

Statistics indicating population growth over the three decades from 1950-80 are shown in Table 5.2.2. As can be seen by the figures provided, the river region has increased its relative share of the state's inhabitants.

5.2.10. Employment/Labor Force

Table 5.2.3. compares civilian employment trends in the project area in 1980 with May of 1983. As indicated in the table, the project area is experiencing the effects of the current economic cycle.

5.2.11. Endangered/Threatened Species

The U. S. Fish and Wildlife Service and the National Marine Fisheries Service were contacted to determine what endangered/threatened species might be found in the project area. This coordination resulted in the identification of the endangered Kemp's ridley sea turtle and the threatened green and loggerhead sea turtles as the three species of concern within the project area.

TABLE 5.2.2.

POPULATION TRENDS

| AREA | 1950 | 1960 | % INCREASE | 1970 | % INCREASE | 1980 | % INCREASE |
|---|---|---|---|---|---|---|---|
| Baton Rouge SMSA | 212,415 | 299,755 | +41.4 | 375,628 | +25.3 | 494,151 | +31.6 |
| Non-SMSA Parishes | 84,547 | 110,511 | +30.7 | 129,067 | +16.8 | 148,886 | +15.4 |
| New Orleans SMSA | 712,393 | 907,123 | +27.3 | 1,046,470 | +15.4 | 1,187,485 | +13.5 |
| Total Project Area | 1,009,355 | 1,317,389 | +30.5 | 1,551,165 | +17.7 | 1,830,522 | +18.0 |
| % of State | 37.6 | 40.4 | | 42.6 | | 43.5 | |

Source: U. S. Bureau of the Census (1951; 1961b; 1971; 1982)

TABLE 5.2.3.

CIVILIAN LABOR TRENDS

| | Baton Rouge SMSA | Non-SMSA Parishes | New Orleans SMSA | TOTAL | % of State |
|---|---|---|---|---|---|
| 1980 (Annual Average) | | | | | |
| Labor Force | 222,800 | 77,275 | 501,400 | 801,475 | 44.8 |
| Employment | 209,400 | 71,600 | 471,300 | 752,300 | 45.1 |
| Unemployment | 13,400 | 5,675 | 30,100 | 49,175 | 40.6 |
| Rate of Unemployment | 6.0 | 7.3 | 6.0 | 6.1 | - |
| May 1983 | | | | | |
| Labor Force | 230,000 | 76,825 | 506,300 | 813,125 | 43.9 |
| Employment | 206,200 | 67,450 | 450,300 | 723,950 | 44.7 |
| Unemployment | 23,800 | 9,425 | 56,000 | 89,225 | 38.5 |
| Rate of Unemployment | 10.3 | 12.3 | 11.1 | 11.0 | - |

Sources: Louisiana Department of Labor (1982; 1983b).

### 5.2.12. Energy

A large volume of energy-related products are transported annually on the Mississippi River between Baton Rouge and the Gulf of Mexico. Much of this mineral production originates in the project area; in 1975, the total was more than 31 percent of the value of all minerals produced in the state and more than 4 percent of those produced nationwide (U. S. Department of the Interior, 1979). Crude petroleum, natural gas, and natural gas liquids made up the vast majority of the total. Large volumes of inbound petroleum, as well as outbound coal, also move on the waterway. Because the river offers a highly efficient means for transporting bulk commodities and general cargo, the availability of the deep-draft channel has resulted in enormous fuel savings.

### 5.2.13. Esthetic Values

Within the delta there is a rare blending of marsh and natural levee forest interspersed with expanses of estuarine water bodies and winding bayous. Along the Mississippi River are located plantation mansions from a bygone era, scattered small towns and communities, and the urban centers of Baton Rouge and New Orleans. French and Spanish architecture dating back to the 17th century may be found in New Orleans, which is an unusually charming and interesting city steeped in old world tradition. The Vieux Carre, or French Quarter, is a national showpiece.

### 5.2.14. Estuarine Water Bodies

These open-water bodies of varying sizes, shapes, and depths are located throughout the marshes of the project area and adjacent to the Mississippi River and its distributaries. These often warm, turbid, and relatively shallow (approximately -10 feet NGVD and less) waters undergo salinity and temperature changes throughout the year. These changes are

a function of Mississippi River discharge, winds, and tidal action. Estuarine water bodies are used as nursery areas by many important commercial species of finfish and shellfish. These water bodies are rich in benthic fauna which are important constituents of the estuarine food web. Marsh creation within the project area is accomplished within these water bodies. An analysis of data reported by Wicker (1980) reveals there were approximately 200,000 acres of estuarine water bodies present in 1956 and approximately 266,300 acres present in 1978. This net increase is a result of the loss of marsh and levee forest countered by a gain of scrub/shrub habitat. The trends of change for these habitats, when projected, results in a 1985 base-condition figure of approximately 277,700 acres of estuarine water bodies.

5.2.15. Fisheries

5.2.15.1. The Mississippi River and its distributaries, dredged canals, marshes, and estuarine water bodies provide habitat for a variety of aquatic species of commercial and recreational importance.

5.2.15.2. According to Kelly (1965), the fresh and intermediate marshes, distributary channels, and dredged canals on the Delta National Wildlife Refuge support many species of freshwater fish. These fish appear to inhabit waters where salinities are less than 5 parts per thousand. The freshwater sport fishes include largemouth bass, yellow bass, black crappie, bluegill, warmouth, channel catfish, and blue catfish. Freshwater fish of commercial importance include alligator gar, blue catfish, and channel catfish. Strong currents and high ambient turbidities, coupled with extensive saltwater intrusion during low-flow periods, limit freshwater fish populations in the Mississippi River between Venice and the mouth of Southwest Pass. Data collected by the U. S. Fish and Wildlife Service (1976) revealed that the project area supported 18,000 man-days of freshwater sport fishing in 1968 with an estimated harvest of 45,000 pounds.

5.2.15.3. The marshes and associated estuarine water bodies of the project area are used by various life stages of many estuarine-dependent species that take advantage of the protection from predators, warmer water temperatures, optimal salinity regimes, and the rich detrital food chain. Many important sport and commercial species depend on marsh areas. They include the Atlantic croaker and spot (Rogers, 1979), menhaden (Simoneaux, 1977), brown and white shrimp (White and Boudreaux, 1977), and blue crab (More, 1969). Conner and Truesdale (1973) demonstrated the value of marsh to juvenile brown and white shrimp, gulf menhaden, Atlantic croaker, sand seatrout, and southern flounder. Data collected by the U. S. Fish and Wildlife Service (1976) indicated that in 1968 the project area supported 39,000 man-days of saltwater sport finfishing, 18,000 man-days of sport shrimping, and 3,000 man-days of sport crabbing. The commercial saltwater finfish/shellfish harvest for Plaquemines Parish was estimated by the National Marine Fisheries Service to be in excess of 17 million pounds in 1977 and 18.1 million pounds in 1978. The jetties at the mouth of Southwest Pass occasionally are utilized by fishermen seeking red drum, Atlantic croaker, and spotted seatrout.

5.2.15.4. Benthic communities of the Mississippi River at Venice are euryhaline, tolerating large variations of salinity. The presence of saltwater in the river for extended periods limits the species of benthic organisms that can inhabit the river bottoms. According to Demas (1983), Corophium, an amphipod, the polychaetes Nereis and Asebellides, the nemertean Carinoma, and other polychaete worms were the organisms that occurred most frequently and in the greatest abundance; Tortopus, a mayfly and the blue crab were present at all sample sites. Many invertebrates live in the marshes and mudflats: fiddler, mud, and hermit crabs; marsh periwinkles; olive nerites; ribbed mussels; and the coffee melampus. Other invertebrates inhabiting the mudflats include nematodes, polychaete worms, amphipods, and ostracods. Invertebrates characteristic of Southwest Pass include molluscs such as lucines,

tellins, shark's eyes, and baby's ears. Boring organisms such as the isopod Sphaeroma and the molluscs Teredo and Marterisa can occur in the wood pilings in Southwest Pass.

5.2.15.5. Phytoplankton populations are limited in the Mississippi River below Venice and its distributaries as a result of high ambient turbidities. Important groups of zooplankton found in the river are crustaceans (copepods and cladocerans) and rotifers. In the estuarine water bodies adjacent to Southwest Pass, a variety of zooplankton are present. The calcanoid copepod, Acartia, is most abundant. Crustacean larvae are seasonally dominant, especially in the spring and fall. Diatoms and dinoflagellates are the most dominant species of phytoplankton.

5.2.16. Income

Table 5.2.4. compares per capita personal income (current dollars) in the project area with that of the State of Louisiana and the United States.

5.2.17. Marsh

5.2.17.1. The project area contains four types of marsh: fresh, intermediate, brackish, and saline. According to Chabreck and Linscombe (1978), fresh marsh is dominated by maidencane[1/], pennywort, pickerelweed, alligatorweed, and bulltongue. Intermediate marsh commonly contains bulltongue, cattail, sawgrass, roseau, bullwhip, and Walter's millet. Brackish marsh is characterized by wiregrass, three-cornered

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[1/] All common and scientific nomenclature of plants mentioned in this EIS follow Montz (1975a; 1975b) and are listed in EIS Appendix A, "Common and Scientific Names of Plants."

TABLE 5.2.4.

PER CAPITA PERSONAL INCOME TRENDS

| | 1969 ($) | 1979 ($) | 1980 ($) |
|---|---|---|---|
| Baton Rouge SMSA | 3,219 | 8,234 | 9,435 |
| Non-SMSA Parishes | 2,481 | 7,409 | 8,476 |
| New Orleans SMSA | 3,542 | 8,657 | 9,791 |
| Project Area | 3,376 | 8,442 | 9,588 |
| State of Louisiana | 2,854 | 7,480 | 8,456 |
| United States | 3,714 | 8,638 | 9,511 |

Source: U. S. Department of Commerce (1982).

grass, and leafy threesquare. Saline marsh is dominated by oystergrass, black rush, saltwort, and saltgrass. For the purposes of this EIS, the four marsh types identified above will be consolidated into two categories, fresh marsh and nonfresh marsh, with nonfresh marsh including intermediate, brackish and saline marshes. This is necessary because the intermediate, brackish, and saline marshes, which exist within the project area, were not differentiated from each other, but rather were identified as intermediate marsh in Wicker (1980). Wicker (1980) indicated that total marsh within the project area has declined from approximately 134,000 acres in 1956 to approximately 66,000 acres in 1978. When this 1978 acreage is updated to 1985, the project base condition, it is reduced to approximately 54,000 acres of marsh. Fresh and nonfresh marsh would comprise approximately 32,000 and 22,000 acres of this 1985 figure, respectively. This suggests that marsh loss is a serious problem within the project area.

5.2.17.2. The project area marshes function as nursery areas for many estuarine species of finfish and shellfish and support a rich and varied benthic fauna. These invertebrates, and their larval stages, are important constituents of the food web and are essential for the production of economically important finfish and shellfish species. The marshes also serve as a source of plant detritus which is a basic element of the food web, as documented by Odum et al. (1973). Turner (1979) has further identified the value of Louisiana coastal marshes by reporting that the commercial inshore shrimp catch is directly proportional to the area of intertidal wetlands and that the area of estuarine water bodies does not seem to be directly linked to shrimp yields.

5.2.17.3. A variety of birds, mammals, reptiles, and amphibians also is supported by the project area marshes. Migratory waterfowl and other important game birds make extensive use of the marshes during the winter months. In addition, many species of nongame birds occur there. The

marshes support a number of valuable furbearers and game mammals, as well as various species of small mammals.

### 5.2.18. Mississippi River/Navigation

The Mississippi River and its tributaries form the world's largest drainage system, encompassing an area in excess of 1.2 million square miles, comprising parts of 31 states and 2 Canadian provinces. This represents about 41 percent of the total land area of the contiguous 48 United States. The Mississippi River is the mainstem of the world's most highly developed waterway system, about 12,350 miles in length. The authorized 40-foot-deep channel below Venice, Louisiana, is approximately 30 miles long and was completed in 1963. Between 1964 and 1980, annual maintenance dredging quantities for this 30-mile reach has averaged 20 million cubic yards per year. This amount of shoaling has resulted in 40-foot and 38-foot channel depths 70 percent and 87 percent of the time, respectively. Subsidence and erosion within this reach have led to both the loss of natural river banks and river widening in several areas, with associated increasing overbank flow. This loss of river water, although beneficial to surrounding marshes, has resulted in increased shoaling within the navigational channel. At New Orleans, the Mississippi River intersects the Gulf Intracoastal Waterway (GIWW), a 1,170-mile long barge canal extending from Florida to the Mexican border. Traffic on the Mississippi River below Baton Rouge has increased dramatically in recent years. Total tonnage has grown from 90 million tons in 1960 to 400 million tons in 1981. Over the same period, the tonnage at the Port of Baton Rouge increased from 26.6 million to 72.0 million tons, while traffic at the Port of New Orleans increased from 56.7 million to 188.9 million tons. Table 5.2.5. displays traffic movements at the two ports from 1971 through 1981. In 1981, the Port of New Orleans ranked first in total tonnage among the nation's leading ports while the Port of Baton Rouge ranked sixth. About 45 foreign trade consuls and commissioners have offices in New Orleans. The

TABLE 5.2.5.

TRAFFIC AT THE PORTS OF BATON ROUGE AND NEW ORLEANS,
1971-1981
(1,000 of short tons)

| | Port of New Orleans | | | | Port of Baton Rouge | | | |
|---|---|---|---|---|---|---|---|---|
| | Total | Imports | Exports | Domestic | Total | Imports | Exports | Domestic |
| 1971 | 120,067 | 8,796 | 21,608 | 89,663 | 47,017 | 7,715 | 5,966 | 33,336 |
| 1972 | 125,719 | 8,149 | 28,886 | 88,684 | 52,903 | 8,314 | 7,710 | 36,879 |
| 1973 | 136,104 | 10,360 | 36,112 | 89,632 | 53,569 | 9,737 | 7,105 | 36,727 |
| 1974 | 144,189 | 13,537 | 37,188 | 93,464 | 59,126 | 14,427 | 7,660 | 39,039 |
| 1975 | 140,409 | 12,205 | 35,454 | 92,750 | 60,226 | 11,995 | 8,413 | 39,818 |
| 1976 | 155,990 | 16,101 | 41,555 | 98,334 | 66,703 | 15,265 | 9,591 | 41,847 |
| 1977 | 162,992 | 25,214 | 39,074 | 98,704 | 70,008 | 16,826 | 8,679 | 44,503 |
| 1978 | 160,612 | 23,298 | 40,481 | 96,833 | 74,570 | 16,900 | 11,432 | 46,238 |
| 1979 | 167,135 | 27,160 | 43,019 | 96,956 | 76,703 | 16,156 | 12,903 | 47,644 |
| 1980 | 177,346 | 21,646 | 52,131 | 103,539 | 79,347 | 13,435 | 15,878 | 50,034 |
| 1981 | 188,851 | 20,663 | 59,490 | 108,698 | 72,045 | 11,312 | 14,372 | 46,361 |

Sources: U. S. Army Corps of Engineers (1971 through 1981a).

feasibility report for the Mississippi River Ship Channel (Deep-Draft) study is presently under consideration for authorization by the U. S. Congress. Deep-Draft would provide for a 55-foot-deep navigational channel between Baton Rouge, Louisiana, and the Gulf of Mexico. A final EIS addressing the Deep-Draft study was filed with the U. S. Environmental Protection Agency on July 2, 1982.

5.2.19. National Register of Historic Places

5.2.19.1. Within the active delta, no presently eligible or existing National Register of Historic Places sites occur. However, numerous sites are recognized as having the potential for inclusion on the Register by various agencies. Examples of such sites are: Burrwood, Old Stone Lighthouse (1838), Southwest Pass Cast Iron Lighthouse (1871), Pilotville/Pilot Lookout (1815, 1891), Custom House (1891), Building Group (1891), Pilottown, Quarantine Station, and the Jump. Determination of eligibility for these known sites has not been undertaken to date.

5.2.19.2. Southwest Pass, from a historical perspective, has been a very active area. During the later part of the 19th century, a pilot station was still maintained there. Along with the pilot station, the small community of Burrwood, with its residences and business establishments, was still active and remained so until World War II. The Cast Iron Lighthouse remained the guiding beacon into Southwest Pass until 1958 while the Old Stone Lighthouse slowly deteriorated. Upriver, a custom house and three associated buildings continued to operate through the turn of the century, only to be destroyed by subsequent hurricanes.

5.2.20. Natural Levee Forest

This forest type is confined primarily to the subsiding natural banks of Tiger, Grand, and Raphael Passes, as well as the west bank of

the Mississippi River between miles 3 and 10 Above Head of Passes. This forest is characterized by black and sandbar willow, green ash and Drummond red maple, and scattered persimmon and baldcypress. Natural levee forest is important to a number of species of wildlife, particularly white-tailed deer and migratory passerine birds. According to Wicker (1980), these forests have declined rapidly within the project area from a total of 6,750 acres in 1956 to 2,350 acres in 1978. This rate of loss, when projected, results in a 1985-base-condition figure of approximately 950 acres.

### 5.2.21. Nesting Colonies

There are six active seabird and wading bird nesting colonies, comprised of 2,700 to 12,100 adult birds, within the project area (Keller, pers, comm. Aug. 1, 1983). In addition, there are three possible Least Tern colonies. These Least Tern colonies were previously reported by Portnoy (1977); however, they were not detected during Keller's 1983 aerial survey. In addition to Least Terns, the colonies are comprised of Great Egrets, Snowy Egrets, Louisiana Herons, Little Blue Herons, Black-crowned Night Herons, White-faced and/or Glossy Ibis, White Ibis, Gull-billed Terns, Forster's Terns, and Black Skimmers. Disposal of dredged material along Southwest Pass has provided nesting habitat for seabirds such as Gull-billed Terns, Forster's Terns, Least Terns, and Black Skimmers. The locations of these active and possible nesting colonies are depicted on Plate 23.

### 5.2.22. Noise

Navigational vessels and channel maintenance activities are the primary sources of noise within the project area. Wildlife populations coexist with the noise levels created by these activities. The areal extent of the project area, coupled with the confinement of most human-related noise to the navigational channel, has allowed species which are

sensitive to such noise levels to locate at sufficient distances from the navigational channel. The human inhabitants of the project area are conditioned to existing noise levels.

5.2.23. Pass a Loutre Waterfowl Management Area

The 66,000-acre Pass a Loutre Waterfowl Management Area is owned and administered by the Louisiana Department of Wildlife and Fisheries. It is located in the southernmost part of Plaquemines Parish, between the south bank of Pass a Loutre and the east bank of South Pass (see Plate 1). The taking of waterfowl and rabbits are the only forms of hunting permitted on the management area. In addition to hunting, the marshes and estuarine water bodies of the management area support recreational activities such as fresh and saltwater fishing, crabbing, shrimping, camping, and boating. During the period July 1, 1980, to June 30, 1981, total recreational use on the management area, including hunting, amounted to 53,231 man-days (U. S. Fish and Wildlife Service, 1982). A trapping program is conducted annually to control surplus furbearing animals.

5.2.24. Plan Economics

5.2.24.1. One measure of benefits to the recommended project is the difference between transportation costs with and without the project. The measurement of these benefits differs somewhat from those computed in the traditional manner because the purpose of both the existing project and the recommended project is to maintain a 40-foot channel in the Mississippi River and Southwest Pass. For the without project condition, maintenance of this depth is becoming progressively more difficult because of deteriorating channel stability.

5.2.24.2. There is firm evidence that even with the existing project in place and an increased level of dredging, the project depth would be

unattainable for an increasingly longer period of time. Thus, the probability of the full 40-foot depth being available for navigational purposes would diminish. For the with project condition, channel stability would be greatly increased and a much higher level of usage of the 40-foot depth would be assured. The project benefit measurement is a direct result of the increased utility to navigational interests because the availability of greater depths normally allows for the passage of deeper vessels at reduced costs.

5.2.24.3. The feasibility report, "Deep-Draft Access to the Ports of New Orleans and Baton Rouge, Louisiana," dated July 1981, provided rationale for the enlargement of the Mississippi River from 40 to 55 feet. The basic economic data set forth in that report were utilized in this analysis to depict the transportation costs that would occur in the future if the 40-foot channel could not be maintained because continued shoaling would lessen the channel depth available to shipping. The same basic data were employed to depict the decreased transportation costs that would occur with the project in place and the vessel operating costs that would occur with the project in place. The vessel operating costs were updated to reflect 1983 price levels, and the average annual benefits were computed at the authorized interest rate of 2 5/8 percent, as well as at the current 8 1/8 percent rate.

5.2.24.4. The transportation cost of a movement associated with a given draft includes the line haul cost of transporting the commodity plus loading and unloading costs that might be expected to result from making the movement, using a fleet of deep-draft vessels that can be accommodated by the given draft. In other words, transportation costs of grain exports from New Orleans at a 35-foot draft are the vessel costs and load/unload costs associated with moving the grain in a fleet of vessels of 35-foot or less draft. This statement does not mean that all vessels in this fleet would draw 35 feet, but that the fleet would have a reasonable distribution of drafts 35 feet or less. Detailed

explanations of the computerized transportation cost methods used, as well as the conceptual issues implicit in the computation structure, are included in the above-mentioned Deep Draft Report.

5.2.24.5. The methods outlined here implicitly assume that, in the aggregate, the shipper's alternative to deep-draft ships during periods of reduced channel depths is generally vessels of smaller draft. Issues related to multiport analysis and diversions of cargo from the Mississippi River that might eventuate with deteriorating average channel conditions in the future are not addressed in this analysis. Similarly, adaptions to deterioration of the channel, such as lightering, provision of offshore loading/unloading facilities, scheduling, and stockpiling by users that would allow continued, albeit less efficient use of the vessels now using the river, have not been considered as alternatives to movement in smaller ships. Finally, the question of whether certain cargoes could economically continue to move at all has not been addressed. It has been assumed that, in both the with and without project conditions, existing levels of cargo as projected over the life of the project would continue to use the Mississippi River and would be transported in vessels that would meet the constraints imposed by the effective channel depth existing at the time that the cargo is shipped. The element of timing to ease impacts of possible seasonality in draft restrictions, as well as awaiting offshore during short periods of restricted draft, also have been ruled out as alternatives. Analysis of these issues was beyond the scope of the current study.

5.2.25. Property Values

Property values in the project area are increasing as economic development continues and the population increases. The continued growth of port activities, mineral production and processing, commercial activities, construction, and tourist trade require the dedication of

progressively more land for urban usage. Because there is a relative scarcity of suitable flood-free sites around New Orleans and downriver, the natural urban growth has continued to drive the price of real property higher. Another factor influencing property values has been the "sunbelt's" relatively mild climate, attracting more people as the cost of energy has increased.

### 5.2.26. Public Facilities And Services

Public facilities and services vary from those too numerous to mention which are typically found in large urban centers to those basics (roads, utilities, drainage) which are available in the more rural locales.

### 5.2.27. Recreation

Recreational activities in the project area are outdoor-oriented. Hunting, fishing, boating, shrimping, crabbing, birdwatching, and picnicking are the principal recreational activities. The Delta National Wildlife Refuge and Pass a Loutre Waterfowl Management Area provide consumptive and nonconsumptive recreational opportunities. Fresh and saltwater fish are caught in the canals, marshes, bayous, and estuarine water bodies in the vicinity. The Mississippi River below Venice and its major distributaries provide only limited recreational opportunity because of their size and strong currents; however, adjacent marshes attract outdoor recreationalists. In the Mississippi River, four boat launch sites are located in Venice. These marinas and public launch areas provide water access for fishermen to use the major passes and canals, as well as to gain access to the Gulf of Mexico from the Mississippi River. The baseline projection in 1985 for big game hunting, small game hunting, waterfowl hunting, freshwater sport fishing, saltwater sport finfishing, sport crabbing, and shrimping is 779,000 man-days of use valued at approximately $4,386,000.

5.2.28. Regional Growth

Port and transportation activities have been a significant factor in the project area's regional growth. As discussed previously, a large amount of the industrial activity, employment, income, and the area's tax base has been either directly or indirectly linked to deep-draft traffic on the waterway.

5.2.29. Scrub/Shrub Uplands

This habitat type develops on dredged material disposed in an upland condition. Montz (1977) defines uplands as areas above approximately 2.0 NGVD. Scrub/shrub uplands are characterized by black and sandbar willow, rattlebox, eastern baccharis, marsh elder, coffeeweed, nightshade, seaside heliotrope, Bigelow glasswort, thoroughwort, Bermuda grass, and dogtooth grass. This habitat is utilized primarily by rabbits, small mammals, and, to a lesser extent, white-tailed deer. Wading birds utilize more isolated areas of this habitat for nesting. Seabirds utilize isolated areas of barren to partly vegetated dredged material for nesting as well. If left undisturbed, scrub/shrub upland vegetation will colonize barren dredged material within approximately five growing seasons. According to Wicker (1980), there were approximately 1,900 acres of scrub/shrub uplands present in the project area in 1956 and approximately 8,000 acres in 1978. This rate of increase, when projected, results in a 1985 base-condition figure of approximately 10,000 acres. This increase is attributable to increased dredging and disposal activities in the project area during the same period. Approximately half of this habitat is located along Southwest Pass.

### 5.2.30. Tax Revenues

The tax base of the project area is heavily dependent upon income generated, either directly or indirectly, by port and port-related activities. In a report prepared by Viana Maritime Systems, Inc. (1980), for the Board of Commissioners of the Port of New Orleans, it was estimated that state tax revenues generated by port activities in New Orleans totaled $142,776,000 in 1978, while the total volume of state tax revenues generated by foreign trade, at the Ports of Baton Rouge, New Orleans, and other points along the river and gulf coast, was $252,200,000. The source of these revenues include taxes from personal and corporate income, general sales, beverages and tobacco, gasoline and special funds, as well as taxes levied on corporate franchises.

### 5.2.31. Water Quality

5.2.31.1. Although the area directly affected by the project would be the navigational channel and a narrow strip on either side, water quality would be affected throughout the active delta south of Venice. There are no municipal or private water intakes in this area; so, the primary water quality concern is the water's ability to sustain and stimulate aquatic and wetland plants and animals. At present, Mississippi River waters inundate the delta when the discharge volume at Venice exceeds approximately 400,000 cubic feet per second (cfs). Based on historical records, this level of flow normally occurs from February through June of each year. During this period, the river maintains a cool, high-dissolved-oxygen (DO), low-salinity, and high-nutrient environment in the overbank and also supplies land-building sediment.

5.2.31.2. During river discharges under approximately 300,000 cfs, the 15 parts per thousand isohaline occupies the area approximating the outline of the delta. This flow level typically occurs during August through December of each year. During this warm period, lower DO, high

salinity, and lower nutrient gulf water enters the overbank area with the highest tendencies toward these characteristics in the deeper areas. Less sediment is carried by these lower river flows resulting in less overbank sediment deposition during this period.

5.2.31.3. The months of July and January typically bring intermediate flow volumes (300,000-400,000 cfs). At this discharge range, the 2 parts per thousand isohaline occupies the area approximating the outline of the delta. Water quality conditions are a mix of the previous two descriptions.

5.2.31.4. Although the three conditions described above are extremely generalized, they point out important seasonal trends. A long-term trend is the increasing water depths in the overbank area of the delta. Because of complex interactions involving subsidence, erosion, sea level rise, and reductions in river-borne sediment, water depths in the overbank are increasing which allows saline gulf water to intrude along the bottom. The interaction of all of these factors and the effects of oil/gas industry activities have resulted in a marsh loss rate of over 3,000 acres per year in the active delta. Approximately 75% of these marsh acres were lost from the area between Venice and the latitude of Head of Passes. See Appendix E, "Water Quality," for a complete discussion of circulation, salinity, DO, nutrient, and related land-loss trends.

5.3.31.5. Ambient levels of pollutants in water and sediment are well documented. Ambient river water average concentrations are below EPA acute criteria for all priority pollutants. EPA chronic criteria are exceeded by the average concentrations for cadmium, chromium, copper, DDT, and dieldrin. Only cadmium and chromium exceeded the criteria by a factor of ten. These data imply that ambient river water might exceed the toxic metal tolerances of some forms or species of freshwater aquatic life. On the other hand, conservative criteria, wide ranges in

species tolerances, the ability of species to de-toxify themselves, and the wide range of river discharges might reduce or eliminate the actual impacts of these concentrations. See Appendix E for data and a full discussion of these issues. Concentrations of pollutants in delta sediments appear consistent over time. Comparing 1975-76 sample results with 1982 sample results indicated regular appearance of certain key pollutants. These key sediment contaminants in the delta are arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, chlordane, DDT, DDE, DDD, dieldrin, PCB's, and phthalate esters. Each of these pollutants adsorbs to the sediment, resists biological and chemical degradation, and can be bioconcentrated. There are no criteria or standards by which to evaluate the ambient levels of these pollutants; however, because of their potential for bioaccumulation, each of them could be magnified through the food web to intolerable levels. These same pollutants have been found in natural marsh areas near the mouths of many of the nation's rivers. Mississippi Delta sediment quality levels are in the lower end of the ranges of concentrations reported for the nation's natural marshes. Refer to Appendix E for data and a full discussion.

5.2.32. Wildlife

The project area, with its diverse habitats, is populated by a variety of mammals, birds, reptiles, and amphibians. Nutria, muskrat, mink, river otter, and raccoon are trapped commercially. Nutria are most commonly found in the fresh marshes while the muskrat favors brackish marsh. The river otter and mink occur along the numerous bayous and minor passes while the raccoon uses all the habitats at various times. Other mammals include the white-tailed deer and the swamp rabbit which are found in the natural levee forest, scrub/shrub uplands, and marsh. Large populations of migratory waterfowl inhabit the project area marshes and estuarine water bodies during the winter. These waterfowl species include Lesser Snow Geese, White-fronted Geese,

Blue-winged Teal, Mallards, Northern Pintails, American Green-winged Teal, Gadwall, American Wigeon, Northern Shovelers, Lesser Scaup, Greater Scaup, Redheads, Ring-necked Ducks, Hooded Mergansers and Canvasbacks. The Mottled Duck is a resident species of waterfowl in the project area. In addition, American Coots, Common Gallinules, Purple Gallinules, rails, Amercian Woodcock, Mourning Doves, and Common Snipe are important project-area game bird species. Raptors, wading birds, shorebirds, seabirds, and waterbirds are nongame species present in the project area. These include Marsh and Red-shouldered Hawks, American Kestrels, and Ospreys; egrets, ibis and herons; sandpipers, Willets, Black-necked Stilts, and Killdeer; gulls, terns, and Black Skimmers; and grebes, loons, cormorants, and White Pelicans. Numerous migratory and resident passerine birds use the project area as well. Frogs, toads, turtles, and snakes are common in the project area. The bullfrog and pig frog are sought for both commercial sale and sport. Commercially important reptiles occurring in the marshes include the American alligator, common snapping turtle, and alligator snapping turtle. Common snakes are the diamond-backed water snake, broad-banded water snake, and western cottonmouth. Mosquitoes are important vectors for various strains of viral encephalitis within the project area.

## 6.0. ENVIRONMENTAL EFFECTS

### 6.1. GENERAL

6.1.1. This section contains a description of without project and with project impacts on the previously described significant resources. This section supplements Table 4.4., "Comparative Impacts," with more detailed discussions of impacts noted in the table.

### 6.2. AIR QUALITY

6.2.1. Without the project, increased shoaling within the Mississippi River below Venice and Southwest Pass would lead to an increase in the number of dredges used and the duration of their operation. The associated increase in exhaust emissions associated with these dredging activities would not be expected to cause significant deterioration of existing Class II air quality, nor would it impact the Class I air quality of Breton Island National Wildlife Refuge.

6.2.2. With the project, exhaust emissions would increase over present, but would be less than under without project conditions. There would not be any deterioration of existing Class II air quality. The Breton Island National Wildlife Refuge, the only Class I area in Louisiana, is over 15 miles from any construction or maintenance activites and, therefore, would not be expected to be impacted.

### 6.3. AUDUBON SOCIETY "BLUE LIST" SPECIES

6.3.1. Without the project, continued maintenance of the navigational channel within the project area would result in the creation of between 23,000 and 28,400 acres of marsh and approximately 14,000 acres of scrub/shrub uplands. Creation of these habitats, with the food and cover they provide, would benefit the "Blue List" species. The loss of

project area natural levee forest (950 acres) to subsidence (including sea-level rise) and erosion would eliminate an important habitat type and probably would result in the more rapid movement of migrant arboreal species through the project area.

6.3.2. With the project, construction and maintenance of the navigational channel within the project area would result in the creation of between 9,000 acres and 13,600 acres of marsh and 2,100 acres of scrub/shrub uplands. Creation of these habitats, with the food and cover they provide, would benefit the "Blue List" species, although proportionately less than under without project conditions. The loss of natural levee forest would be slightly accelerated (by 70 acres) over what would occur without the project. Again, the loss probably would cause migrant arboreal species to move more rapidly through the project area than at present.

6.4. BUSINESS AND INDUSTRIAL ACTIVITY

6.4.1. Without the project, shipping interests would be forced to alter their methods of operation because of the continued deterioration of the channel conditions. This would include the diversion of traffic to other ports and result in a major restructuring of the project area's economic base because of the declining port activities. Satellite and service industries would be affected seriously. Business and industries in the midwest, related to grain production, would be impacted adversely. They would experience a loss of competitiveness in world markets and exports would suffer.

6.4.2. With the project, the continued growth of New Orleans, Baton Rouge, and the river region as a whole would be obtained with the continued maintenance of a 40-foot channel depth in the river and pass. The significance of waterborne commerce to the project area is

illustrated in the report prepared by Reinecke and Fisher (1981) entitled "Economic Impact of the Port of New Orleans." They state that:

> (1) more than half of this $10 billion of goods and services produced annually in the area are in some way dependent on oceangoing commerce; (2) over a fifth of the half-million jobs in the area can be traced in one way or another to Port activities; (3) almost a fourth of the wages paid in the area can be linked to the Port.

As displayed in Table 6.4.1., the same report provided information regarding the economic impacts of the Port (including Jefferson, Orleans, Plaquemines, St. Bernard, St. Charles, and St. Tammany Parishes).

The "value added" is representative of the difference between total sales revenue generated and the cost of materials in the process of generating such revenues. In summary, maintaining the 40-foot channel would have a substantial beneficial impact on the business and industry of the project area. It would discourage the ultimate decline of traffic and related business activities on the waterway and facilitate the continued economic growth of the project area.

## 6.5. COMMUNITY COHESION

6.5.1. Without the project, with the long-term decreases in channel depth and the corresponding adverse economic impacts, community cohesion would decrease. This would be the result of outmigration in the industrial and service sectors, outmigration of employees and their families, higher unemployment rates, and lower incomes.

6.5.2. With the project, normal development of port and port-related activities could occur with implementation of the project. This would

TABLE 6.4.1.

REVENUE AND VALUE-ADDED
IMPACTS OF WATERBORNE COMERCE
ON THE NEW ORLEANS AREA, 1977

| | Revenues ($1,000's) | Value Added ($1,000's) |
|---|---|---|
| DIRECT IMPACTS: | | |
| Direct Vessel Disbursements | 543,958 | 264,403 |
| Banking, Insurance, & Legal Services | 58,700 | 52,830 |
| Inland Transportation | 222,400 | 200,160 |
| Other Port Services | 436,300 | 392,670 |
| Total Direct Impact | 1,261,358 | 910,063 |
| INDIRECT IMPACTS: | | |
| Food Manufacturing | 322,891 | 59,218 |
| Petroleum Refining | 1,570,375 | 262,852 |
| Chemicals and Plastics Manufacturing | 530,371 | 229,514 |
| Shipbuilding & Repair | 443,660 | 242,230 |
| Other Manufacturing | 181,233 | 76,884 |
| Government | 99,336 | 99,336 |
| Total Indirect Impact | 3,147,866 | 970,034 |
| Sum of Direct and Indirect Impacts | 4,409,224 | 1,880,097 |

Source: Reinecke and Fisher (1981).

provide major contributions towards community well being. Increased levels of community cohesion which are associated with a stable economic climate would be supported by a continuation of the development of port activities along the New Orleans-Baton Rouge river corridor.

## 6.6. COMMUNITY GROWTH

6.6.1. Without the project, economic stagnation would occur in communities along the river with a decline in waterway traffic. These communities depend, to a large extent, on port-related activities for employment and income. In the larger communities, economic contraction over an extended period of time probably would occur causing the increased outmigration of inhabitants seeking employment in more favorable environs. This would produce a continued erosion of the tax base and limit the ability to offer general public services.

6.6.2. With the project, continued growth of waterborne commerce would facilitate the expansion of related economic activities and community developments.

## 6.7. DELTA NATIONAL WILDLIFE REFUGE

6.7.1. Without the project, freshwater flow into the refuge would increase as the adjacent Mississippi River bank subsides. The creation of 4,200 acres of marsh and 4,100 acres of scrub/shrub uplands Above Head of Passes, resulting from maintenance of the navigational channel, would not impact the refuge directly, as displayed on Plate 22. The presence of created marsh adjacent to the refuge, however, should serve as a valuable source of food and cover. Commercial fishing, trapping, rabbit hunting, and outdoor recreational activities associated with the refuge should, in turn, benefit from this additional food and cover for wildlife and fish.

6.7.2. With the project, the two existing freshwater outlets which supply river water to the refuge would be preserved with the project, as displayed on Plates 8 and 9. Table 20 and Plates 3, 4, and 5 in Appendix E, "Water Quality," display the flow distribution and isohaline positions for low, medium, and high-flow conditions. Examination of these data and Table 6 of Appendix E reveals that freshwater flows would be increased to the refuge and that saltwater intrusion would not occur during low-flow conditions. The nutrients and sediment provided with these freshwater flows should prove beneficial to the refuge and its fish and wildlife resources. The creation of approximately 400 acres of marsh adjacent to the refuge, as displayed on Plate 21, would be beneficial. The various refuge recreational and commercial activities would benefit from creation of marsh adjacent to the refuge.

6.8. DISPLACEMENT OF FARMS

6.8.1. Without the project, because of reduced channel depths, grain movements would be performed in a more costly manner. Less efficient farms and farming on marginally productive land would be eliminated or consolidated because of the increased costs associated with the transportation of output.

6.8.2. With the project, maintaining the channel at a sufficient depth would facilitate the continued flow of agricultural commodities. No farmland would be impacted by project construction.

6.9. DISPLACEMENT OF PEOPLE

6.9.1. Without the project, a decline in employment opportunities would occur with the requirements for reduced vessel drafts. Employment would decline in the transportation industries and in related service industries. This decline in employment opportunities would have a corresponding impact on the area's population, inducing unemployment rate increases and substantial outmigrations.

6.9.2. With the project, maintaining the channel would facilitate normal economic growth and employment. The project would add stability to employment in the transportation service industries and prevent population displacements to those working in transportation industries. Table 6.9.1. compares population trends as reflected by the 1980 OBERS BEA Regional Projections. These figures are based on the assumption that the project area's share of the state's total employment would be "... held constant throughout the projection period." The channel of the Mississippi River probably would be maintained and the related economic developments would continue. The projections for the Non-SMSA parishes are based on growth rates projected for the Non-SMSA portion of BEA Economic Area 114: Baton Rouge, of which these parishes are a part.

6.10. EMPLOYMENT/LABOR FORCE

6.10.1. Without the project, port activities along the waterway eventually would be reduced mainly because of diversion of commodities through other ports. Both direct and indirect employment opportunities would be adversely impacted. As port operations decline, unemployment rates would increase and outmigration of part of the labor force would follow.

6.10.2. With the project, maintenance of the channel at its authorized depth would facilitate the continued growth of port activities and related employment opportunities. Indirect and induced employment would continue.

6.11. ENDANGERED/THREATENED SPECIES

6.11.1. Without the project, the creation of 23,000 to 28,400 acres of marsh, as a result of continued maintenance dredging, would benefit the Kemp's ridley, green, and loggerhead sea turtles by enhancing their food

TABLE 6.9.1.

POPULATION PROJECTIONS

| | 1980 | 1990 | 2000 | 2030 | 2046 |
|---|---|---|---|---|---|
| Baton Rouge SMSA | 494,151 | 516,438 | 559,396 | 662,406 | 724,000 |
| Non-SMSA Parishes | 148,886 | 162,700 | 176,300 | 206,400 | 225,000 |
| New Orleans SMSA | 1,187,485 | 1,327,657 | 1,443,682 | 1,717,879 | 1,887,000 |
| Project Area | 1,830,522 | 2,006,795 | 2,179,378 | 2,586,685 | 2,836,000 |
| % of Louisiana | 43.5 | 44.2 | 44.5 | 44.7 | * |

* The 2046 data are based on an extension of the 2000-2030 growth rates.

Sources: U. S. Bureau of the Census (1982).

U. S. Department of Commerce (1981).

supply in an area of declining forage because of subsidence and erosion. Toxic materials, which could be released into this marsh from adjacent upland disposal, would present a potential for bioaccumulation.

6.11.2. With the project, the creation of 9,000 to 13,600 acres of marsh in a project area where natural marsh is declining as a result of subsidence and erosion would enhance the food supply of these sea turtles. However, the potential for bioaccumulation of some toxic material through the food web exists. Additional information on contaminants can be found in Appendix E, "Water Quality." Construction and maintenance activities would not be expected to adversely impact the turtles. Additional information on potentially affected species can be found in Appendix B, "Biological Assessment of Endangered/Threatened Species."

6.12. ENERGY

6.12.1. Without the project, in the absence of maintenance of the waterway at sufficient channel depths, a large portion of commodity movements would have to be accomplished by less efficient means, requiring the use of considerably more energy.

6.12.2. With the project, maintenance of the channel at sufficient depths would facilitate the continued movements of vital resources with minimal excess expenditures of energy.

6.13. ESTHETIC VALUES

6.13.1. Without the project, pressures for additional urbanization/ industrialization would be reduced and thereby would lessen the need for the loss of undeveloped lands.

6.13.2. With the project, the continuation of economic growth, which is anticipated with maintenance of the 40-foot channel, would require the conversion of currently undeveloped areas for urban-type use including residential, industrial, manufacturing, commercial, and public. This development probably would not occur in the active delta but rather upriver. Urban improvements which incorporate attractive art forms and interesting abstract figures might afford new opportunities for human appreciation. The rock foreshore dikes would drastically alter the appearance of the Mississippi River banks between Venice, Louisiana, and the Head of Passes. This change would be less dramatic in Southwest Pass where channel-training structures, such as rock dikes and lateral pile dikes, are common.

6.14. ESTUARINE WATER BODIES

6.14.1. Without the project, there would be a maximum 42,400-acre reduction of estuarine water bodies by the year 2042 as a result of marsh and scrub/shrub uplands creation.

6.14.1. With the project, there would be a maximum 13,600-acre reduction of estuarine water bodies by the year 2042 as a result of marsh creation. A scrub/shrub upland barrier might be constructed along the east side of Southwest Pass, below mile 8.8, for the purpose of providing a sheltered area for marsh creation. Such a barrier could eliminate an additional area of estuarine water bodies, although probably no more than a few hundred acres.

6.15. FISHERIES

6.15.1. Without the project, overbank flow along the Mississippi River below Venice and Southwest Pass would increase as a result of subsidence and erosion of existing banks. This increased flow would freshen the 23,000 to 28,400 acres of marsh which would be created along the river

and pass. Fresher conditions in the marshes along Southwest Pass would favor species like white shrimp, blue crab, gulf menhaden, and Atlantic croaker, at the expense of species like brown shrimp, sand seatrout, spotted seatrout, and red drum. Maintenance dredging activities would increase until an equilibrium point would be reached at which 54.2 million cubic yards of shoal material would be dredged annually. This would be a significant increase over the existing 20-million cubic yard figure. Increases in the extent and duration of maintenance dredging activities probably would further reduce the limited value of the river and pass to fisheries. There would be a potential for bioaccumulation of contaminants as a result of marsh creation. A discussion of potential bioaccumulation is contained in Appendix E, "Water Quality."

6.15.2. With the project, construction of the foreshore dikes and bank nourishment would result in the loss of approximately 1,500 acres of Mississippi River and Southwest Pass shallow water and water bottoms. An additional 300 acres of deeper river waters and water bottoms would be impacted within the limits of the bank nourishment borrow areas, located between miles 3.5 and 10.0 AHP and displayed on Plates 6 through 9. The jetties, inner bulkheads, and fill pumped between them would eliminate approximately 600 acres of shallow pass waters and water bottoms. The lateral pile dikes, if constructed in the future, would eliminate approximately 900 acres of river and pass waters and water bottoms. The flotation channels and associated disposal activities would impact approximately 700 acres of river and pass waters and water bottoms. Construction of the recommended features, including the lateral pile dikes, would, therefore, result in the loss of a total of approximately 3,000 acres of shallow river and pass waters and water bottoms. This would represent a loss of the benthic organisms that inhabit these river and pass bottoms and the loss of valuable feeding habitat for fish species within the river and pass. The rock foreshore dikes and jetties would provide some additional habitat diversity which partially would offset the loss of the river and pass bottoms (CERC,

1981). The fish species inhabiting the river and pass would not be expected to suffer any significant adverse impacts because of their mobility and ability to use adjacent distributaries and estuarine water bodies as food sources. During construction, turbidity levels would increase within the river and pass; however, this impact upon fish, planktonic, and benthic species would be localized and reduced because these organisms are adapted to high ambient turbidities.

6.15.3. A total of 1,000 acres of both deep and shallow river and pass waters and water bottoms would be temporarily impacted by the project (700 acres by flotation channels and 300 acres by borrow areas AHP). During construction activities, benthic populations would be destroyed and turbidities would be increased. Demas (1983) and Diaz and Boesch (1977) have investigated the impact of hydraulic dredging on riverine benthic organisms and they found that recolonization by these organisms occurred within approximately 3 months. This rate of recolonization can probably be attributed to the transport of organisms from upstream locations and the resilience of the indigenous benthic species which are adapted to naturally unstable physical conditions in the rivers. Increased turbidities associated with construction would not be expected to significantly affect fish or planktonic species because the turbidity would be localized, and ambient turbidities are high.

6.15.4. Table 20 in Appendix E, displays the existing and with project flow distributions for low, high, and 12-month average Mississippi River flows at Venice, Louisiana. Plates 3, 4, and 5 in Appendix E display the existing and with project isohalines for low, average, and high flows, respectively. An examination of these data reveals that, with the exception of areas adjacent to Southwest Pass, little saltwater intrusion would occur. The freshwater outlets, by providing freshwater during low-flow conditions, would contribute to preservation of the existing isohalines and provide nutrients to adjacent marshes and estuarine water bodies. These outlets are displayed on Plates 8 and

9. Any saltwater intrusion would tend to favor brown shrimp, spotted and sand seatrout, and red drum. In view of the above information, it appears that the overall impact on fisheries resulting from project impacts on isohalines should be minimal.

6.15.5. Between 9,000 and 13,600 acres of marsh would be created with the project by the year 2042. This gain of marsh would be viewed as a significant positive impact on fisheries in light of the rapid loss of marsh presently occurring in the project area, and also the relationship of marsh to commercial fisheries yields reported by Turner (1979) and Cavit (1979). On the other hand, as discussed in Appendix E, increases in sediment-adsorbed contaminants in created tidal marshes adjacent to Southwest Pass could pose additional risk of adverse impact to recreational and commercial fisheries resources. As discussed in Sections 3.7. and 3.8. of Appendix E, current analyses of river and marsh sediment show slightly higher contaminant levels for the river sediment and the marsh created with dredged material than for the natural marsh. Contaminants showing higher levels in either the river sediment or recently created marsh include PCB's, chlordane, DDD, DDE, dieldrin, cadmium, and phthalate esters. Vegetative growth and contaminant bioaccumulation by marsh plants growing in the dredged marsh and naturally accreted marsh sediments were used as criteria to determine the short-term acute toxic effects and bioaccumulation potential of marsh plants after intertidal disposal. The results suggest no short-term acute toxic effects of contaminants present in dredged sediments on the producivity of marsh vegetation. The plant bioaccumulation results indicate a potential for bioconcentration of PCB's, mercury, and three phthalate esters [Bis-(2-Ethylhexyl) Phthalate, Butyl Benzyl Phthalate, Di-N-octyl Phthalate] for marsh plants after intertidal disposal. The results of faunal bioaccumulation studies indicate there might be some potential for cadmium and mercury bioconcentration by benthic organisms under intertidal conditions. The comparison of dredged-sediment interstitial water levels with the U. S. EPA reported levels for chronic

impacts suggests some potential for chronic impacts of cadmium on benthic populations after marsh creation.

6.15.6. No definite conclusions can be made, however, with regard to possible impacts upon nursery populations of shrimp and fish which use these marshes other than to say that there is a potential for a slight population reduction with a subsequent reduction in adult populations in offshore gulf areas. No significant direct impact on gulf populations of shellfish or finfish should occur because of the large dilution factor that estuarine water bodies would impart to any sediment or contaminant that would leach from the bank nourishment or created marshes. The slow release of detritus from these marshes and dilution of the detritus by the estuarine water bodies also greatly reduce the possibility of any direct adverse impacts on recreational or commercial fisheries resources of nearby gulf waters. No significant adverse impact would occur to recreational or commercial fisheries resources from release of contaminants in the river during construction activities, maintenance dredging, or dredging of flotation channels. The dilution factor of the Mississippi River appears adequate to rapidly reduce sediment contamination levels to ambient.

6.15.7. In the final analysis, the public must judge between the limited potential for bioaccumulation of contaminants by finfish and shellfish, resulting from marshes created from dredged material, and the documented value of these same marshes to the productivity of fish and shellfish. Any judgement would be made in the face of a relatively rapid decline of project-area marshes, approximately 3 percent (3,000 acres) annually, between 1956 and 1978.

6.16. INCOME

6.16.1. Without the project, any long-term reduction of river traffic would have major negative impacts on overall income levels because a substantial portion of regional income is port related. As mentioned previously, approximately $1.3 billion of the 1977 production revenues in the New Orleans area was directly related to port activities with approximately $3.1 billion related indirectly. If channel restriction results in a significant reduction of this output, both directly and indirectly, associated incomes would be impacted negatively.

6.16.2. With the project, with completion of the recommended project, incomes derived directly and indirectly from port and port-related activities would increase with the normal growth of commodity movements. Per capita income relative to that of the remainder of the United States would be maintained.

6.17. MARSH

6.17.1. Without the project, the hydraulic dredging and unconfined overbank disposal of shoal material would result in the creation of between 23,000 and 28,400 total acres of marsh by the year 2042. Of these totals, fresh marsh would comprise 17,700 acres, while nonfresh marsh would comprise between 5,300 and 10,700 acres. Section 4.1.8., "Maintenance Procedures," contains a discussion of how these ranges of marsh acreages were derived. Plate 22 displays the location and extent of these marshes. Subsidence and erosion would continue to diminish the banks of Southwest Pass, causing the marshes adjacent to the pass to become fresher than at present. Appendix E, "Water Quality," and Section 6.15., "Fisheries," contain discussions of the potential for bioaccumulation of contaminants associated with the created marshes. Marsh creation would serve to add to project-area marsh acreages. These marshes would increase fish and wildlife populations within the active

delta and thus provide commercial and recreational benefits, as discussed in Section 4.3., "Mitigation Requirements."

6.17.2. With the project, the hydraulic dredging and unconfined overbank disposal of shoal material would result in the creation of between 9,000 and 13,600 total acres of marsh by the year 2042. Of these totals, fresh marsh would comprise 900 acres while nonfresh marsh would comprise between 8,100 and 12,700 acres. Plate 3 in Appendix E displays the intrusion of saltwater adjacent to Southwest Pass which would make marshes there nonfresh. Appendix E and Section 6.15. contain discussions of the potential for bioaccumulation of contaminants associated with the created marshes. These marshes would increase fish and wildlife populations within the active delta and thus provide commercial and recreational benefits as discussed in Section 4.3., "Mitigation Requirements."

6.18. MISSISSIPPI RIVER/NAVIGATION

6.18.1. Without the project, because of channel instability, the authorized project depth of 40 feet would be unattainable for increasingly longer periods of time. Shoaling and associated dredging within the Mississippi River below Venice and within Southwest Pass would increase until an equilibrium point was reached. This equilibrium point would involve the dredging of 54.2 million cubic yards of shoal material annually, as compared to the present quantity of 20 million cubic yards. This 54.2 million cubic yards of dredging would maintain 40-foot and 38-foot channel depths 10 percent and 50 percent of the time, respectively. Over time, increasingly larger navigational losses would result because of inefficiencies related to reduced-draft restrictions, e.g., use of small vessels, diverting shipments through other ports, lightering, use of offshore facilities, schedule changes, and inventory increases. Subsidence and erosion would be expected to increase the surface area of the river by approximately 350 acres. This widening is expected to occur between Head of Passes and Venice.

6.18.2. With the project, shoaling and associated dredging within the Mississippi River below Venice and within Southwest Pass would decrease by 7.3 million cubic yards to 12.7 million cubic yards annually. This decrease would occur within the jetty reach only. This decrease in shoaling would result in 40-foot and 38-foot channel depths 90 percent and 97 percent of the time, respectively. With the adoption of the recommended project, the authorized channel depth of 40 feet would be more effectively maintained, assuring the efficient use of existing port facilities on the river and the orderly development of future expansions. Shipping costs would be minimized, thus providing a stronger basis for increased export trade. Over the life of the project, average annual transportation savings of $942,230,000 would be realized. Construction of the foreshore dikes and bank nourishment would eliminate 1,500 acres of river from Venice to the Gulf. The inner bulkheads, jetties, and the fill between them would eliminate an additional 600 acres of river. The river borrow areas would temporarily impact 300 acres of river and river bottoms. The flotation channels for construction of the foreshore dikes and the disposal areas associated with the excavation of these flotation channels would temporarily impact 700 acres of river bottom. The lateral pile dikes, although not presently recommended, would eliminate approximately 900 acres of river bottoms. The locations of the project features, with the exception of lateral pile dikes, are displayed on Plates 6 through 20.

6.19. NATIONAL REGISTER OF HISTORIC PLACES

6.19.1. Without the project, the impacts of natural processes on the cultural resources of the active delta would be major. Subsidence, which is a prevalent feature in this area, would take its toll on most remaining structures. Overbank flooding during seasonal high-water periods would further degrade the existing sites. The constant and heavy ship traffic through Southwest Pass would produce almost constant swell and surge conditions which would result in serious erosional

problems along the pass banks. This would affect areas like Burrwood and the Custom House complexes. By the year 2042, substantial damage would occur to various standing and buried features. Submerged sites would not be significantly affected. Any effects on such sites would be the result of subsidence and the gradual erosive action of the river. Appendix C, "Cultural Resources," contains additional information.

6.19.2. With the project, construction would not directly affect cultural resources. A determination of the eligibility of the Burrwood site for inclusion on the National Register of Historic Places has been initiated, as provided under the National Historic Preservation Act. Therefore, the foreshore dike in the vicinity of the Burrwood site would be aligned and constructed so as to avoid destruction of standing and submerged cultural features associated with the site. The construction of the bank nourishment feature, in general, could damage undetected cultural sites in the shallow river bottoms adjacent to the existing river and pass banks. Such damage would occur as a result of compression of the sites and/or alteration of the existing electrochemical balance within historic metal materials. In general, however, these impacts would be minimal, when compared to the effects of the natural processes occurring to the year 2042. Appendix C contains additional information.

## 6.20. NATURAL LEVEE FOREST

6.20.1. Without the project, based on trends observed between 1956 and 1978 (Wicker, 1980), natural levee forest is expected to be eliminated from the project area by the year 1990. Subsidence and erosion probably would be the major causes of these natural levee forest losses. White-tailed deer and migratory passerine birds would be adversely affected as a result of the loss of this forest.

6.20.2. With the project, the construction of the bank nourishment feature would eliminate 270 acres of natural levee forest between 1985 and 1987. This would result in the elimination of all project-area natural levee forest by 1989. White-tailed deer and migratory passerine birds would be adversely affected as a result of the loss of this forest.

6.21. NESTING COLONIES

6.21.1. Without the project, the creation of approximately 14,000 acres of scrub/shrub uplands, distributed in a discontinuous manner along the river and pass, would provide extensive areas of nesting habitat for wading birds and seabirds. Extensive disposal activities along the navigational channel would probably displace existing nesting colonies located along Southwest Pass (see Plate 23).

6.21.2. With the project, the creation of approximately 2,100 acres of scrub/shrub uplands could provide nesting habitat for seabirds and wading birds. These scrub/shrub uplands would develop on the bank nourishment and would, as a result, be continuous and readily accessible to predators. This accessibility could limit the successful use of these uplands as nesting habitat.

6.22. NOISE

6.22.1. Without the project, increased dredging activities within the navigational channel would increase noise levels and duration. However, this would not be expected to significantly affect human inhabitants of the active delta. These increases also would not be expected to impact wildlife, particularly migratory waterfowl, because most of the dredging activity would occur during periods when migratory waterfowl would not be present.

6.22.2. With the project, increased noise levels associated with construction activities would be local and relatively short term. The reduction of dredging activities would reduce noise levels slightly. Continued increases in navigation associated with a fully maintained 40-foot channel would result in higher noise levels; however, these increases would be gradual and would not significantly affect humans or wildlife within the active delta.

6.23. PASS A LOUTRE WATERFOWL MANAGEMENT AREA

6.23.1. Without the project, continued maintenance dredging and disposal activities would not result in the creation of marsh or scrub/shrub uplands within, or adjacent to, the management area.

6.23.2. With the project, measures, such as the creation of openings in distributary banks to allow sediment-laden waters to enter shallow ponds, would continue to be used by the Louisiana Department of Wildlife and Fisheries to offset marsh loss within the management area. Table 6 in Appendix E, "Water Quality," displays project-induced changes in flow distribution within Pass a Loutre and South Pass. There would be a slight increase of average flows within both of these passes. The result should be an enhancement of sediment management efforts and fish and wildlife productivity within the management area. This would, in turn, enhance commercial and recreational activities on the management area. As displayed in Plates 3, 4, and 5 in Appendix E, no significant saltwater intrusion would occur with the project features in place.

6.24. PLAN ECONOMICS

6.24.1. Without the project, deterioration of the navigational channel between Venice and the gulf as a result of increased shoaling would result in average annual maintenance costs of $78,584,000 or $70,001,000 at the project interest rate of 2 5/8 percent or the current interest

rate of 8 1/8 percent, respectively. The same reduction in channel depth would result in increased annual navigational costs over those that would exist if present conditions were maintained. The magnitude of these increased average annual navigational costs over the 50-year project life approach the level of with project transportation savings of $942,230,000.

6.24.2. With the project, decreased shoaling within the navigational channel would result in average annual maintenance costs of $23,136,000 or $24,890,000 at the 2 5/8 percent project interest rate or current interest rate of 8 1/8 percent, respectively. This would translate into $45,111,000 over without project conditions. In addition, average annual savings in navigational costs over without project conditions are projected to be $942,230,000 or $672,220,000 based on interest rates of 2 5/8 percent or 8 1/8 percent, respectively. The benefit/cost ratios for the project would be 27.3 to 1.0 or 13.4 to 1.0 based on interest rates of 2 5/8 percent or 8 1/8 percent, respectively. The total cost of construction of the project features (including lateral pile dikes: $9,290,000) would be $341,000,000.

6.25. PROPERTY VALUES

6.25.1. Without the project, if the channel cannot be maintained at project depths sufficient for traffic at current and anticipated future levels, the value of the port and ancillary facilities along the river would decline. This would be a result of the reduced utilization of existing improvement and reduced demand for new developments. Property values would suffer, not only along the river, but, to a lesser degree, throughout the region.

6.25.2. With the project, effectively maintaining the waterway would encourage continued economic growth throughout the project area and would assist in assuring more stable long-term property values.

6.26. PUBLIC FACILITIES AND SERVICES

6.26.1. Without the project, with continued deterioration of channel depths over the project life, oceangoing vessels would be restricted from reaching the Ports of New Orleans and Baton Rouge. This would cause a substantial reduction in the need for the public facilities and services used in accommodating these movements. Additionally, some existing facilities would lie idle and decay over time and would produce additional local problems.

6.26.2. With the project, existing and anticipated future public facilities and services related to port activities would be maintained by the revenues associated with the continued growth and expansion of the tonnage transported over the waterway. This support of the economic base of the region could only be obtained by the maintenance of necessary channel depths.

6.27. RECREATION

6.27.1. Without the project, recreational activities such as hunting, fishing, shrimping, and crabbing would increase within the project area. When compared to the "baseline projection" (see Section 4.3., "Mitigation Requirements"), the without project condition would provide an increase of 433,000 average annual man-days of recreational activity. This would represent an annual recreational value of $1,431,000. Appendix D, "Recreational Resources," contains additional information.

6.27.2. With the project, recreational activities such as hunting, fishing, shrimping, and crabbing would increase within the project area, but not to the extent of without project conditions. When compared to the "baseline projection," the with project conditions would provide an increase of 142,000 average annual man-days of recreational activity.

This would represent a $630,000 average annual benefit. Although the construction of foreshore dikes would eliminate unlimited access to the Mississippi River banks between Venice, Louisiana, and the Gulf of Mexico, access would still be available through the outlets displayed on Plate 8 of Appendix E, "Water Quality." Ship traffic on the river, with the resultant waves, presently limits river bank access, thus forcing most boaters to gain access to the banks through the existing outlets, as displayed on Plate 1 of Appendix E, "Water Quality." Therefore, the net effect of the foreshore dikes on shoreline access should be insignificant. Appendix D contains additional information.

6.28. REGIONAL GROWTH

6.28.1. Without the project, any decline in port activities associated with reduced drafts would seriously impact future growth in the river region. Outmigrations of some existing developments to less desirable ports would occur; activities of businesses along the river which depend on the existence of the 40-foot channel would decline and operations which are presently marginally productive would cease to exist.

6.28.2. With the project, full maintenance of the waterway would facilitate an extension of current economic activity, resulting in continued regional growth.

6.29. SCRUB/SHRUB UPLANDS

6.29.1. Without the project, future maintenance dredging and disposal would result in the creation of 14,000 acres of scrub/shrub uplands. These uplands would be discontinuously distributed adjacent to the Mississippi River and Southwest Pass, between Venice and the gulf.

6.29.2. With the project, the construction of the bank nourishment feature would result in the creation of 2,100 acres of scrub/shrub

uplands. Because dredged material not needed for maintenance of the bank nourishment would be disposed in an unconfined manner within open water, little additional scrub/shrub upland would be created. The existing 3,600 acres of scrub/shrub habitat adjacent to the navigatonal channel would subside to an elevation conducive to marsh development by year 2006 and then be maintained as marsh over the remainder of the project life.

6.30. TAX REVENUES

6.30.1. Without the project, a significant adverse impact on the area's tax base would be caused by a lack of adequate channel depths because of the regional economy's considerable dependence on port-related activities, particularly in the vicinity of New Orleans. Tax rates probably would require raising.

6.30.2. With the project, the modifications would help maintain the economic vitality and viability of the regional economy which, in turn, would continue to generate tax revenues within the project area.

6.31. WATER QUALITY

6.31.1. Without the project, predictions are perhaps the least certain because they provide for uncontrolled evolution of the river delta system. Again, however, the flow distribution would be the key to understanding the water quality changes. Presumably, the without project changes in flow distribution would involve subsiding/eroding river banks, increased shoaling of the navigational channel, and, consequently, increased disposal of dredged material in overbank areas. In fact, annual disposal quantities from Venice to the gulf are projected to approximately double in about 20 years without the project. Because the bulk of overbank flows would move west, falling stages could

decrease flows moving east out Baptist Collette, Cubits Gap, and Pass a Loutre. Therefore, the west overbank would be expected to experience reduced or even no saltwater intrusion while the east overbank could have increasing saltwater influence. Although nutrient and DO levels would not be expected to be limiting in either case, the gradual loss of sediment to the east side could contribute to a greater rate of land loss.

6.31.2. In a corridor adjacent to the navigational channel, many thousands of acres of marsh and upland would be created through dredged-material disposal. These discontinuous areas of marsh and upland, however, are not expected to reduce the increasing rates of westward overbank flow. Therefore, most of these created acres would be flushed well with river water.

6.31.3. Pollutant levels in native water and sediment would be similar to existing levels. The only change in the without project future would result from the many acres created by dredged-material disposal. Data collected from dredged-material marshes, as discussed in Appendix E, "Water Quality," indicate PCB's, chlordane, and cadmium might be released in concentrations exceeding EPA freshwater and marine chronic toxicity criteria during and immediately after disposal activities. Combined with other pollutants with ambient concentrations above criteria, these releases might result in elevated pollutant levels in the created marshes. However, surface waters would be diluted immediately. Only interstitial waters could be expected to represent a potential water quality problem. With adequate flushing from overbank flows, though, this potential problem would be minimized.

6.31.4. Another feature of the without project overbank pollutant level situation is the creation of uncontrolled upland areas in the overbank adjacent to created marshes. Because of oxidation and leaching from these sediments, tests indicate PCB's, chlordane, and cadmium could

continue to be released for several years or more. Release into open-water areas or the river would incur immediate dilution; however, marshes might hold elevated levels in the interstitial water. Higher than existing risks because of bioconcentration and magnification through the food chain could result. Where adequate river discharges flow into the created marshes; however, these risks might not materialize.

6.31.5. With the project, the major impacts would involve the altered flow distribution and its ramifications. Generally, the plan would increase major distributary flow while reducing minor outlet and overbank flows. The east side of the delta AHP would experience slightly increased flows, while the west side and the east side BHP would receive less flow. Although Southwest Pass would carry more water, its west overbank would receive about the same quantity of water as at present. These changes in Southwest Pass would result from outlet closures and restriction of overbank flows. Careful study of the effects of the new flow distribution on isohalines indicates little movement in average salinities. In general, the project would return overbank salinity, nutrient, and DO levels to the conditions typical in the overbank prior to the loss of solid riverbanks during the flood of 1973. Localized salinity changes might affect some vegetation; however, the overall salinity regime would change little from the existing annual patterns. Appendix E, contains additional data and discussions.

6.31.6. As noted in the existing and without project conditions, there remains a chance that certain pollutants may exceed EPA chronic criteria in the marshes created from dredged material. The degree of flushing occurring in these marshes would determine the extent of this problem. Because the bank nourishment feature generally reduces flows to most of the disposal areas, risks in this area might be greater with the project. These risks were extensively evaluated through bioassay and

plant uptake data. Based on these studies, the risks appear acceptable (see Appendix E for data and full discussion).

6.32. WILDLIFE

6.32.1. Without the project, the creation of between 23,000 and 28,400 acres of marsh and 14,000 acres of scrub/shrub uplands would benefit wildlife. This benefit to wildlife is displayed in Table 4.3.1. which summarizes the results of the HEP analysis contained in Appendix H, "Draft Fish and Wildlife Coordination Act Report." The only wildlife evaluation species experiencing net adverse impacts are seabirds like terns and Black Skimmers; however, these impacts were not judged to be significant, as discussed in Paragraph 4.3.3. Potential bioaccumulation of contaminants by wildlife species as a result of marsh creation would be of specific concern, as discussed in Appendix E, "Water Quality." The presence of large areas of upland adjacent to created marshes could increase this bioaccumulation potential by allowing the leaching of contaminants from the uplands into the marshes. There, the contaminants could be taken up by marsh plants and possibly introduced into the aquatic and terrestrial food webs. Disposal of dredged material in an upland fashion could enhance the production of salt-marsh mosquitoes. Such upland areas would have to be drained to reduce this possibility. Marsh creation activities would only slightly enhance populations of salt-marsh mosquitoes. Within the created marsh, steps would be taken to ensure that scour holes, created at the outfall of the hydraulic-dredge pipe, would be filled during disposal operations.

6.32.2. With the project, the creation of between 9,000 and 13,600 acres of marsh and 2,100 acres of scrub/shrub uplands would benefit wildlife, although not to the extent of the without project condition. This benefit is displayed in Table 4.3.1. and Appendix H as discussed in the previous paragraph. Terns and skimmers would experience net adverse impacts, although less than under without project conditions. These

impacts would not be considered significant, as discussed in Paragraph 4.3.3. The potential for bioaccumulation of contaminants by wildlife would exist and is discussed in Appendix E. Production of salt-marsh mosquitoes would be less than under without project conditions because much less upland habitat would be created. Within the created marsh, steps would be taken to ensure that scour holes, created at the outfall of the hydraulic-dredge pipe, would be filled during disposal operations.

# 7.0. LIST OF PREPARERS

The following people were primarily responsible for preparing this Environmental Impact Statement:

| NAME | DISCIPLINE/ EXPERTISE | EXPERIENCE | ROLE IN PREPARING EIS |
|---|---|---|---|
| Mr. David F. Carney | Wildlife Biologist/ Waterfowl Management | 1 yr. EIS Studies, Corps of Engineers (COE) New England Division; 5 yrs. EIS Studies, COE, New Orleans District (NOD) | EIS Coordinator; Effects on Fish and Wildlife Resources |
| Mr. Ronald R. Elmer | Civil Engineer | 8 yrs. Civil Engineer, COE, NOD | Project Engineer, Engineering Input to EIS |
| Mr. Tildon J. Dufrene, Jr. | Civil Engineer | 4 yrs. Project Management, COE, NOD 3 yrs. Hydraulic Engineer, COE, NOD | Coordinated Engineering Input |
| Mr. Jeffrey S. Heaton | Oceanographer Environmental Resources Specialist(Water Quality) | 2 yrs. Oceanographer, Naval Oceanographic Office, Bay St. Louis, MS; 3 yrs. Water Quality Specialist, COE, NOD | Effects on Water Quality; Water Quality Impacts on Biological Resources |
| Mr. John W. Muller | Nautical Archeologist | 2 yrs. Survey/Field Experience, 1 yr. Computer Remote Sensing Experience, COE, NOD | Marine Remote Sensing; Cultural Resources Survey Coordinator |
| Mr. Stephen F. Finnegan | Landscape Architect | 6 yrs., COE, NOD | Effects on Recreational Resources |
| Mr. F. Scott Clark | Wildlife Biologist Ornithology | 3 yrs. EIS Studies, COE, NOD | Endangered Species Assessment |
| Mr. Everett K. Johnson | Supervisory Economist/ Branch Chief | 32 yrs., COE, NOD | Economic Projections |
| Mr. Charles B. O'Connell | Regional Economist/ Navigation | 34 yrs., COE, NOD | Navigational Benefits |
| Mr. Richard J. Manguno | Regional Economist/ Navigation | 7 yrs., COE, NOD | Navigational Benefits |
| Mrs. Judith Z. Gordon | Regional Economist | 10 yrs., COE, NOD | Socioeconomic Impacts |
| Mr. Larry Prather | Economist/Navigation | 4 yrs., COE, NOD | Navigational Benefits |
| Mr. Robert D. Lacy | Regional Economist | 12 yrs. Socioeconomic Assessment, Economic Analysis, COE, NOD | Collection of Historical Socio-Economic Data for EIS |
| Mr. Henry P. Glaviano | English/Technical Writing and Editing | 4 yrs. Technical Writer Editor, The Boeing Company; 12 yrs. Technical Writer/Editor, COE, NOD | Review and Editorial Assistance |
| Mel Inc./ C-K Associates Inc. | Engineering/Environmental Consultants | 3 yrs. Water Quality Investigations, COE, NOD | Water Quality Analyses and Studies |

# 8.0. **PUBLIC INVOLVEMENT**

## 8.1. PUBLIC INVOLVEMENT PROGRAM

8.1.1. Interagency scoping meetings were held on 1 September 1981, and 27 July 1982, to discuss the "Mississippi River, Baton Rouge to the Gulf, Louisiana," project. The 1 September meeting was attended by representatives from the U. S. Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), and the Louisiana Department of Wildlife and Fisheries (LDWF). The purpose of this meeting was to determine the major types of project impacts to be evaluated in this EIS. It was determined that project impacts on marshes, salinities, and water quality would be given emphasis. The 27 July meeting was attended by representatives of the FWS and LDWF. The purpose of this meeting was to review project drawings and make recommendations for project modifications which would reduce adverse project impacts. This meeting also served as a means to answer questions concerning the various project features.

8.1.2. On 7 September 1982, a scoping document for the "Mississippi River, Baton Rouge to the Gulf, Louisiana," project was sent to all interested parties. Those receiving the scoping document were asked to provide comments regarding significant resources to be addressed and impacts to be evaluated in the EIS. Letters were received from the FWS, National Park Service (NPS), NMFS, U. S. Bureau of Mines (BOM), U. S. Environmental Protection Agency (EPA), and the U. S. Federal Highway Administration (FHA). As discussed in Section 8.4., "Public Views and Responses," several project features were modified as a result of the scoping process.

## 8.2. REQUIRED COORDINATION

This EIS is being furnished to members of Congress, Federal and state agencies, and other interested parties for their review and comment. Circulation of this EIS accomplishes the remaining required coordination with the NPS and Louisiana State Historic Preservation Officer (SHPO), as provided under the National Historic Preservation Act, and the NPS, as provided under the Federal Water Project Recreation Act.

## 8.3. STATEMENT RECIPIENTS

The members of Congress, Federal and state agencies, organizations, individuals, and libraries listed on the following page are included in the EIS mailing list. Those entities preceded by an asterisk (*) have received a "Notice of Availability." All others on the list have received this EIS and appendixes for review and comment. Copies of this EIS and appendixes have been sent to the listed libraries.

## 8.4. PUBLIC VIEWS AND RESPONSES

8.4.1. As discussed in Section 8.1., "Public Involvement Program," interagency scoping meetings were held with representatives of the FWS, NMFS, and LDWF. These agencies indicated during the meetings and, in subsequent correspondence, that freshwater outlets should be incorporated into the foreshore dikes and bank nourishment to continue to supply Mississippi River water to areas that otherwise would be isolated from the river. In addition, these agencies emphasized the importance of protecting existing marshes and creating new marsh where possible. The FWS specifically stated that existing Mississippi River flows to the Delta National Wildlife Refuge must be maintained.

Federal

J. Bennett Johnston, U. S. Senator

Russell B. Long, U. S. Senator

Lindy (Mrs. Hale) Boggs, U. S. Congresswoman

Robert L. "Bob" Livingston, U. S. Congressman

Advisory Council on Historic Preservation

*Department of Agriculture, Marine Advisory Agent/Louisiana Cooperative Extension Service

Department of Agriculture, Regional Forester, Forest Service

Department of Agriculture, State Conservationist, Soil Conservation Service

Department of Agriculture, Washington, DC

Department of Commerce, Environmental Assessment Branch, National Marine Fisheries Service

Department of Commerce, National Oceanic and Atmospheric Administration, Office of Ecology and Conservation

Department of Commerce, Regional Director, Southeast Region, National Marine Fisheries Service

*Department of Defense, Waterways Experiment Station, Dredged Material Research Program

Department of Energy, Division of NEPA Affairs

Department of Health and Human Services, Washington, DC

Department of Housing and Urban Development, Regional Administrator, Region VI, Ft. Worth, Texas

Department of the Interior, Assistant Secretary for Program Development and Budget, Office of Environmental Project Review

Department of the Interior, Bureau of Mines

Department of the Interior, Fish and Wildlife Service, Delta NWR

Department of the Interior, Fish and Wildlife Service, Field Supervisor, Lafayette, Louisiana.

Department of the Interior, Fish and Wildlife Service, National Coastal Ecosystems Team

Department of the Interior, Fish and Wildlife Service, Regional Director, Atlanta, Georgia

Department of the Interior, National Park Service, Southwest Region

Department of Transportation - Commander, Eighth Coast Guard District

Environmental Protection Agency, Administrator, Washington, DC

Environmental Protection Agency, Office of Federal Activities (A-104)

Environmental Protection Agency, Regional EIS Coordinator, Region VI

Federal Emergency Management Administration, Washington, DC

Federal Highway Administration, Division Administrator, Baton Rouge, Louisiana

State

Governors Coastal Protection Task Force

Louisiana Department of Commerce and Industry, Research Division

Louisiana Department of Culture, Recreation, and Tourism, Office of State Parks

Louisiana Department of Culture, Recreation, and Tourism, Office of State Historic Preservation Officer

Louisiana Department of Health and Human Resources, Office of Health Services and Environmental Quality

Louisiana Department of Highways, Public Hearings and Environmental Impact Engineer

Louisiana Department of Natural Resources, Coastal Resources Program

Louisiana Department of Natural Resources, Division of State Lands, Coastal Resource Analyst

Louisiana Department of Natural Resources, Division of State Lands, Title & Records Section

Louisiana Department of Natural Resources, Office of Environmental Affairs

Louisiana Department of Natural Resources, Office of Environmental Affairs, Water Pollution Control Division

Louisiana Department of Natural Resources, Office of Forestry

Louisiana Department of Transportation and Development, Office of Public Works

Louisiana Department of Wildlife and Fisheries, Secretary

Louisiana Department of Wildlife and Fisheries, Coordinator, Ecological Studies Section

Louisiana State Planning Office, Policy Planner

Louisiana State University, Associate Director, Sea Grant Program, Center for Wetland Resources

Louisiana State University, Curator of Anthropology, Department of Geography and Anthropology

*Louisiana State University, Ports and Waterways Institute, Center for Wetland Resources

*Louisiana Department of Natural Resources, Coastal Resources Program

*Louisiana State University, Sea Grant Legal Program, Herbert Law Center Metropolitan Regional Clearinghouse, New Orleans, Louisiana

Organizations

*Bonnet Carre' Rod and Gun Club, Environmental Committee

*Cactus Clyde Productions

*Chappepeela Group Sierra Club (Florida Parishes)

*Conservation Foundation

*Delta Chapter Sierra Club, New Orleans, Louisiana

Director, New Orleans, City Planning Commission

Ecology Center of Louisiana, Inc.

Environmental Defense Fund

*Environmental Information Center, Inc.

*Fund for Animals, Inc., Field Agent

*Gulf States Marine Fisheries Commission

*Hittman Associated, Inc., Vice-President

*Jefferson Parish, Environmental Impact Office

*Lafayette Natural History Museum and Planetarium

*Lake Pontchartrain Sanitary District

*League of Women Voters of the United States

*Louisiana Environmental Professionals Association

*Louisiana Shipbuilders and Repairs Association

*Louisiana Tech University, Department of Economics and Finance, College of Administration and Business

*Louisiana Wildlife Federation, Baton Rouge, Louisiana

*Middle South Services Inc., Manager, Environmental Affairs Section

Mississippi Waterway Association, Executive Vice President

Missouri Pacific Railroad Company

*National Audubon Society, Director of Audubon Sanctuaries

*National Audubon Society, Field Research Director

*National Audubon Society, Regional Office, Regional Representative

*National Sierra Club, San Francisco, California

*National Wildlife Federation, Washington, DC

*Natural Resources Defense Council, Inc.

*Orleans Audubon Society

President, Plaquemines Parish Commission Council

*Slidell Sportsmen's League

*South Central Planning and Development Commission

*South Louisiana Environmental Council, Houma, Louisiana

*St. Tammany Environmental Council

*T. Baker Smith & Sons Inc.

*Terrebonne Parish Police Jury, Waterways and Permit Committee

*Thibodaux - Houma Sierra Club

*Trout Unlimited, San Antonio, Texas

*Trout Unlimited, Sanford, Mississippi

*Wildlife Management Institute, South Central Field Representative

Individuals

*Mr. R. W. Collins

*Mr. Michael Haley

Mr. Barry Kohl

*Captain O. T. Melvin, Jr.

*Mr. George Pivach, Jr.

*Mr. Freddy Trosclair, Jr.

Libraries

Department of Defense, U. S. Army Corps of Engineers, New Orleans District Library

Louisiana State University, Coastal Studies Institute Library

Louisiana State University, Library, Government Documents Department

National Audubon Society Library

New Orleans Public Library, Main Library

Plaquemines Parish Public Library, Main Library

University of New Orleans, Earl K. Long Library, Louisiana Collection

8.4.2. In Section 8.1., it was also stated that a scoping document was sent to all interested parties and that several agencies responded. The FWS requested that existing salinities be maintained in the project area. The NPS indicated that the project would not impact the National Park System, the National Wild and Scenic Rivers System, or the National Trails System. In addition, the NPS requested that the EIS address impacts on cultural and recreational resources. The NMFS requested that special concern be given in the EIS to sand seatrout, white shrimp, menhaden, blue crabs, and Atlantic croaker. The NMFS also requested that freshwater outlets be located in areas that have experienced the greatest marsh loss. Finally, the NMFS requested that South Pass be constricted, through the use of training works, to divert flows to Pass a Loutre. The BOM indicated that care should be taken not to disrupt oil and gas facilities during dredging and disposal. The EPA stressed consideration of air quality, water quality, marsh preservation, and natural levee forests. The EPA favored the construction of freshwater outlets in the foreshore dikes and bank nourishment. The FHA indicated the project would not affect the Federal-aid highway system.

8.4.3. In response to the views and concerns expressed during the scoping process, as outlined in Paragraphs 8.4.1. and 8.4.2., the project features were modified. A total of six freshwater outlets have been included as project features. Two of the outlets would maintain the existing volume of Mississippi River water which flows into the Delta National Wildlife Refuge. The other four outlets would provide 50 percent of the low-flow volume of Mississippi River water which presently flows into the area adjacent to the west bank of the Mississippi River between mile 0 and mile 10 Above Head of Passes. This area is experiencing the highest rate of marsh loss in the project area. Dredged material associated with maintenance of the recommended project and not needed for construction or maintenance of the project features, would be disposed into estuarine water bodies adjacent to both the Mississippi River below Venice and Southwest Pass. This unconfined

disposal would produce marsh as a by-product. Approximately 9,000 to 13,600 acres of such marsh would be created over the project life. Constriction of South Pass is planned for future consideration under the "Mississippi River Ship Channel, Gulf to Baton Rouge, Louisiana," (Deep-Draft) project. Questions of authority and economic justification have precluded inclusion of this feature into the "Mississippi River, Baton Rouge to the Gulf, Louisiana," project. As requested by the agencies, the EIS has addressed all those additional concerns outlined in Paragraphs 8.4.1. and 8.4.2.

# 9.0. INDEX, REFERENCES, AND APPENDIXES

## 9.1. TABLE - INDEX TO EIS AND APPENDIXES

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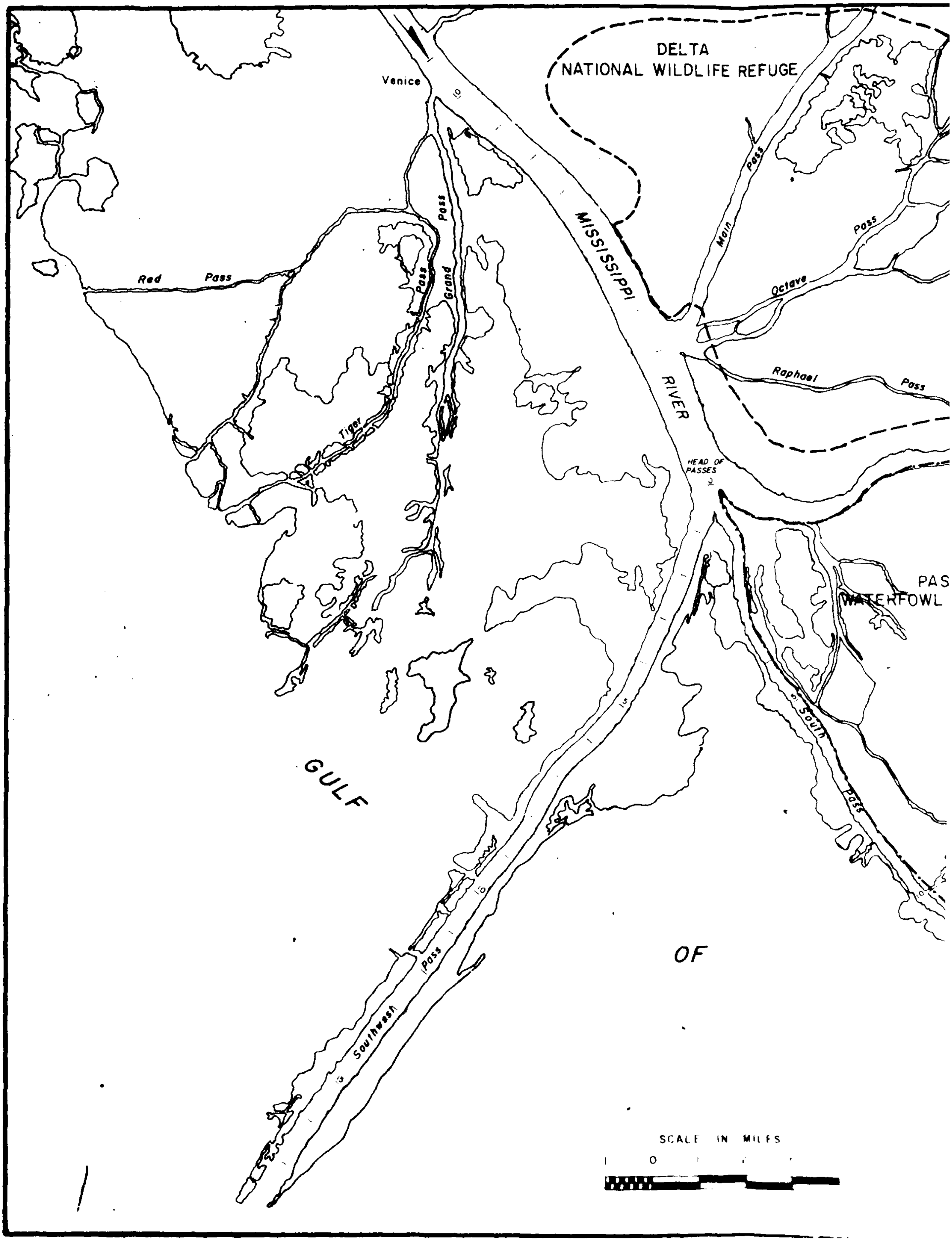
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Tiger
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South Pass
Southwest Pass
GULF
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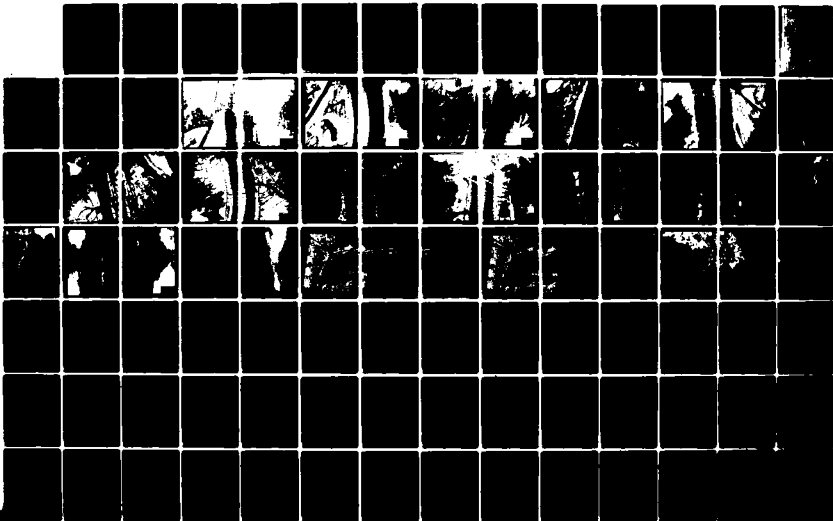

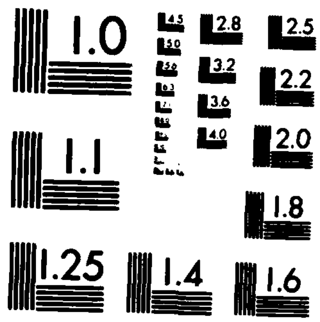


MICROCOPY RESOLUTION TEST CHART
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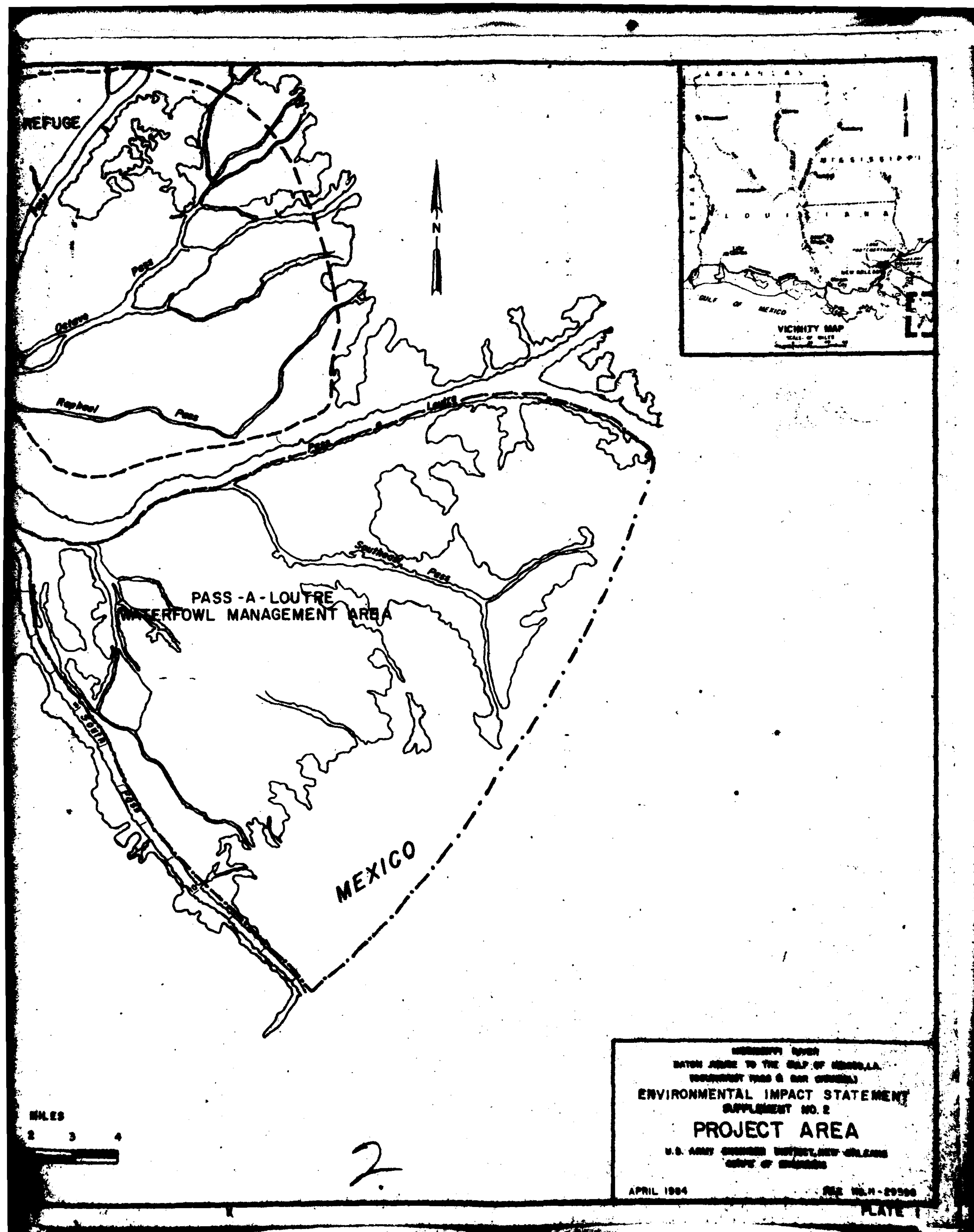
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WATERFOWL MANAGEMENT AREA
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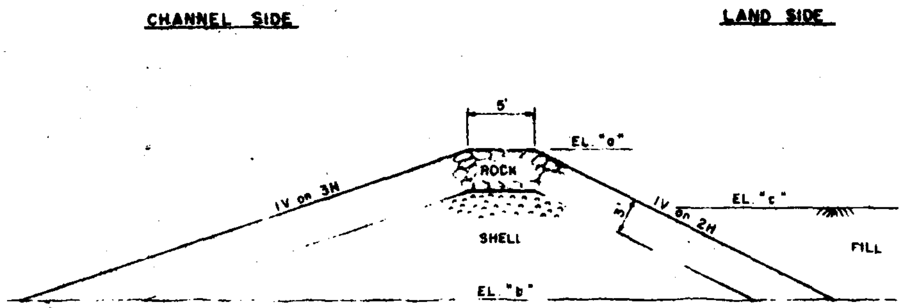
ENVIRONMENTAL IMPACT STATEMENT
PROJECT AREA
APRIL 1984
PLATE 1

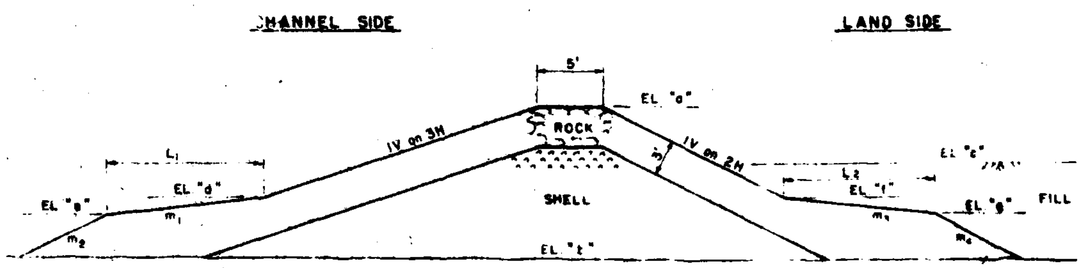
2

SAFETY IS A PART OF YOUR CONTRACT




DIKE SECTION - REACHES W-VII, E-I, E-II, E-III

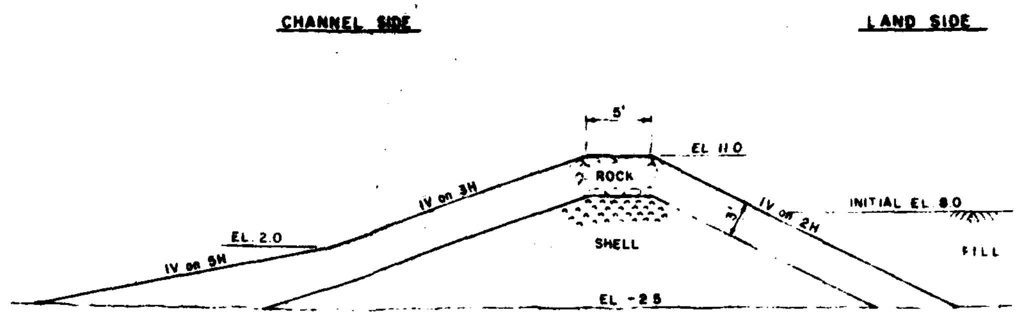
| REACH | LOCATION STATIONS | ELEVATIONS "a" | "b" | "c" |
|---|---|---|---|---|
| W-VII | 981+25-1029+00R BHP | 10.0 | -6.0 | 7.0 |
| E-I | 10+00-585+00L AHP | 11.0 | -2.5 | 7.0 |
| E-II | 0+00-160+00L BHP | 10.0 | -1.5 | 7.0 |
| E-III | 160+00-511+90L BHP | 10.0 | -1.5 | 7.0 |




DIKE SECTION - REACHES W-II, W-III, W-IV, W-VI, E-IV-B, E-IV-C, E-IV-D

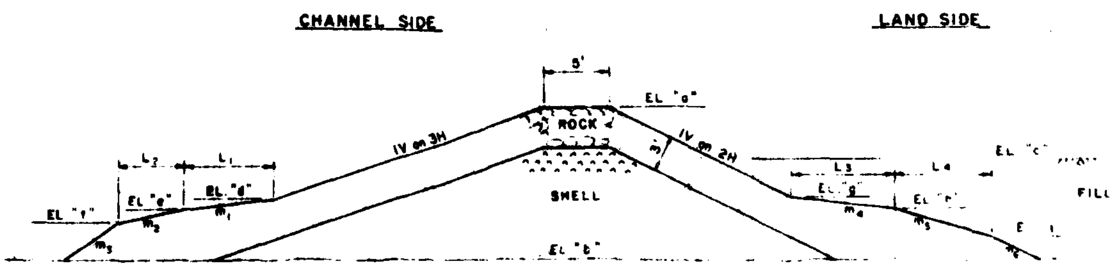
| REACH | LOCATION STATIONS | ELEVATIONS "a" | "b" | "c" | "d" | "e" | "f" | "g" | SLOPES $m_1$ | $m_2$ | $m_3$ | $m_4$ | LENGTHS $L_1$ | $L_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W-II | 110+00-520+00R AHP | 11.0 | -2.5 | 8.0 | – | 2.0 | – | 1.0 | – | 1V on 6H | – | 1V on 5H | 0 | 0 |
| W-III | 0+00-498+60R BHP | 10.5 | -1.5 | 7.5 | – | 2.0 | – | 1.0 | – | 1V on 6H | – | 1V on 4H | 0 | 0 |
| W-IV | 498+60-868+00R BHP | 10.5 | -1.5 | 7.5 | – | 2.0 | – | 1.3 | – | 1V on 9H | – | 1V on 9H | 0 | 0 |
| W-VI | 868+00-981+25R BHP | 10.0 | -6.0 | 7.0 | 0.5 | -3.0 | 0.5 | -3.0 | 1V on 10H | 1V on 3H | 1V on 8.3H | 1V on 3H | 26.6' | 29.0' |
| E-IV-B | 845+00-917+00L BHP | 10.0 | -6.0 | 7.0 | 0.0 | -1.4 | 0.0 | -2.0 | 1V on 10H | 1V on 8.3H | 1V on 8.5H | 1V on 3H | 14' | 17' |
| E-IV-C | 917+00-988+60L BHP | 10.0 | * | 7.0 | -1.5 | -5.0 | 0.0 | -3.0 | 1V on 7.[illegible]H | 1V on 4.8H | 1V on 3H | 1V on 3H | 24.5' | 27' |
| E-IV-D | 988+40-991+25L BHP | 10.0 | * | 7.0 | -2.0 | -2.0 | 0.0 | 0.0 | Horiz. | 1V on 4.7H | Horiz. | 1V on 3H | 6' | 6' |

* GROUND LINE SLOPES FROM EL. -6.0 ON LAND SIDE TO EL. -10.0 ON CHANNEL SIDE




DIKE SECTION - REACH W-I

(STA. 0+80 - 310+00R AHP)




DIKE SECTION - REACHES W-V, E-IV-A

| REACH | LOCATION STATIONS | ELEVATIONS "a" | "b" | "c" | "d" | "e" | "f" | "g" | "h" | "i" | SLOPES $m_1$ | $m_2$ | $m_3$ | $m_4$ | $m_5$ | $m_6$ | LENGTHS $L_1$ | $L_2$ | $L_3$ | $L_4$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W-V | 669+00 - [illegible] | 10.5 | -1.5 | 7.5 | 2.5 | 2.5 | 0.0 | 2.5 | 2.5 | 0.0 | Horiz | IV on 17H | IV on 3H | Horiz | [illegible] | IV on 3H | 5' | 42.5' | 5' | 36.25 |
| E-IV-A | 511+90 - [illegible] | 10.0 | -1.5 | 7.0 | 1.75 | 1.75 | 0.0 | 1.75 | 1.75 | 0.0 | Horiz | IV on 15H | IV on 3H | Horiz | IV on 15H | IV on 3H | 10' | 26.25 | 10' | 26.25 |

NOTE

EL "c" REPRESENTS AN INITIAL FILL ELEVATION. THE NET ELEVATION OF FILL FOR ALL DIKES IS EL. 4.0 BELOW HEAD OF PASS AND EL. 4.5 ABOVE HEAD OF PASS

2

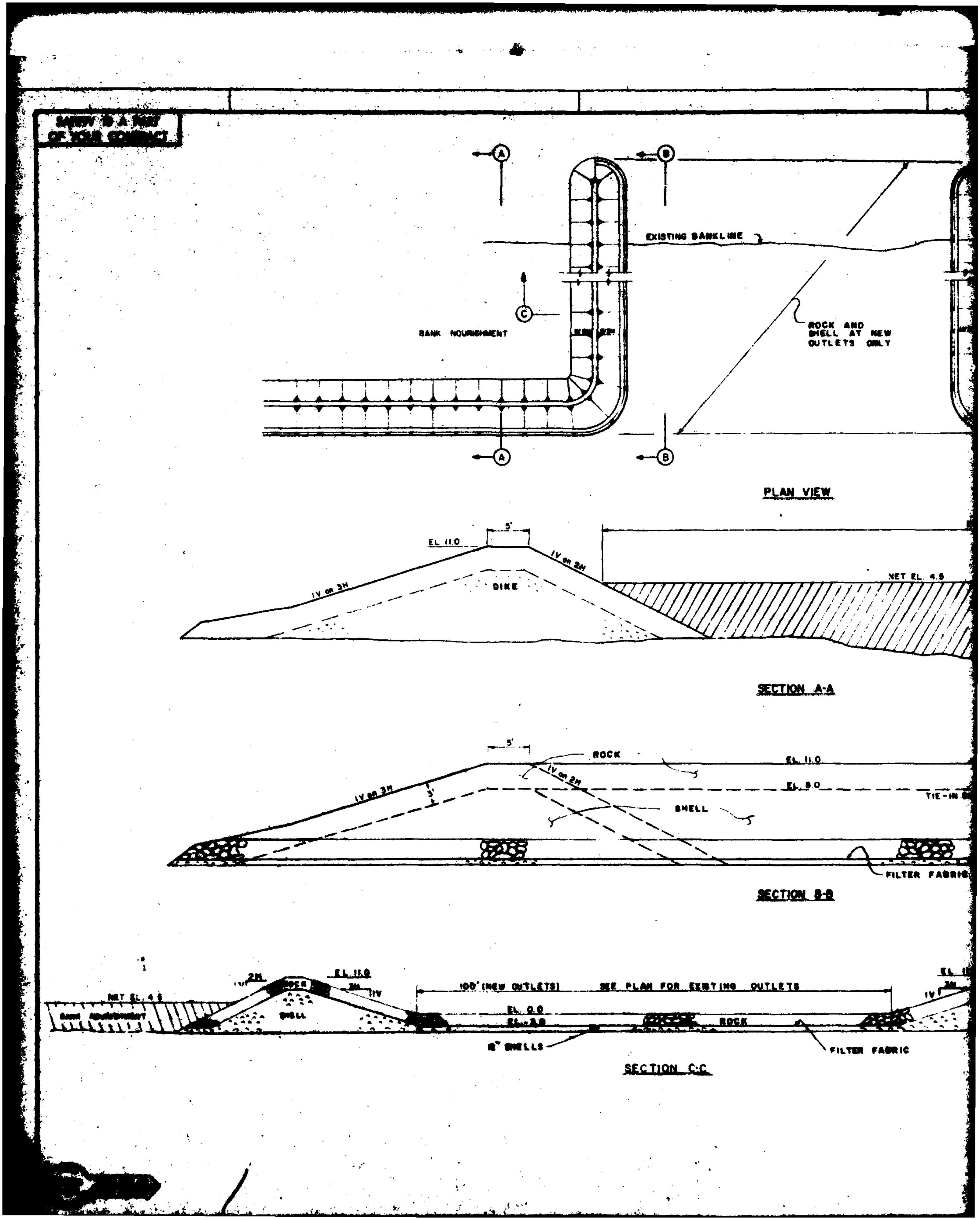
MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO, LA.
(SOUTHWEST PASS & BAR CHANNEL)
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT NO 2

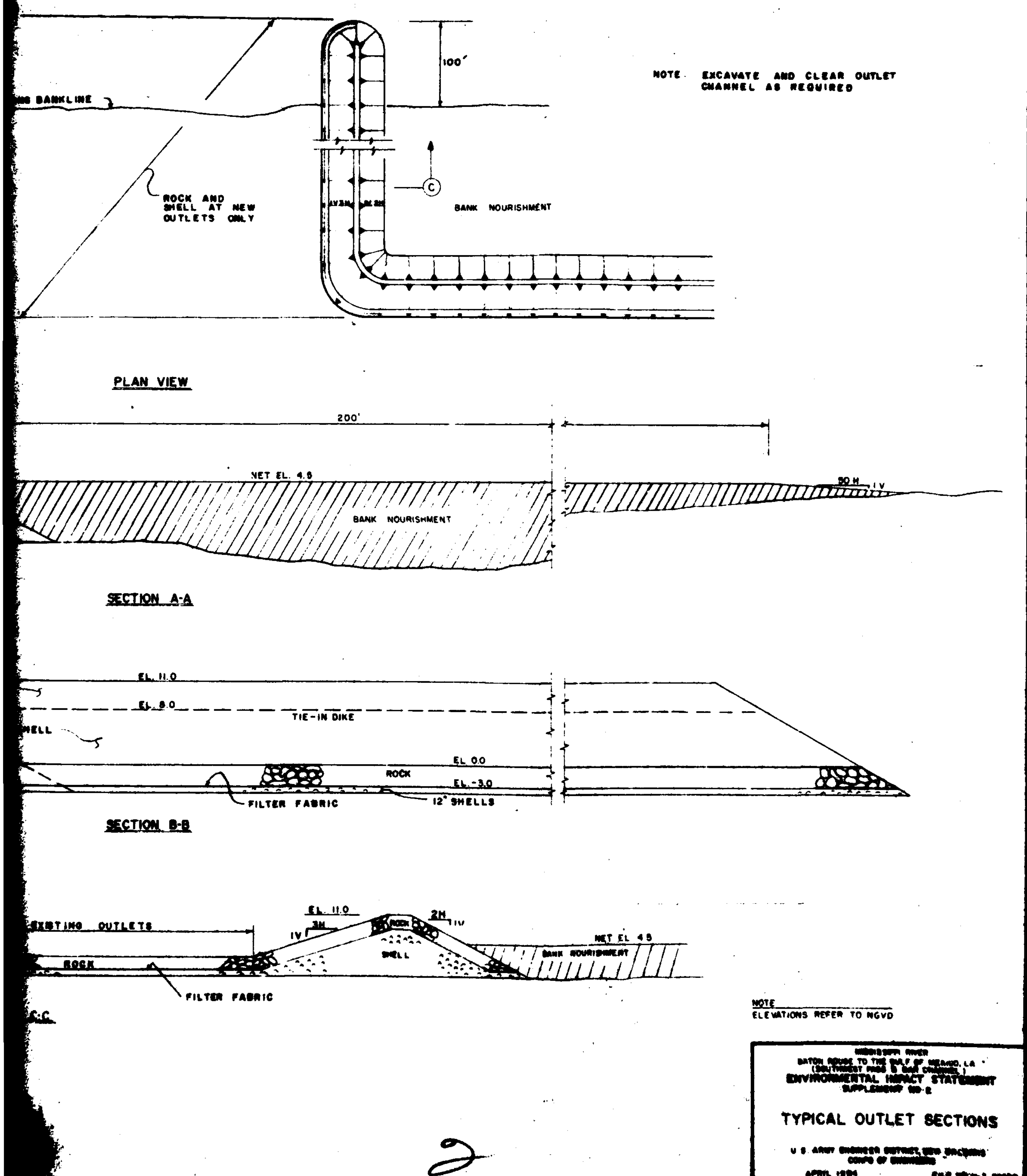
TYPICAL DIKE SECTIONS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

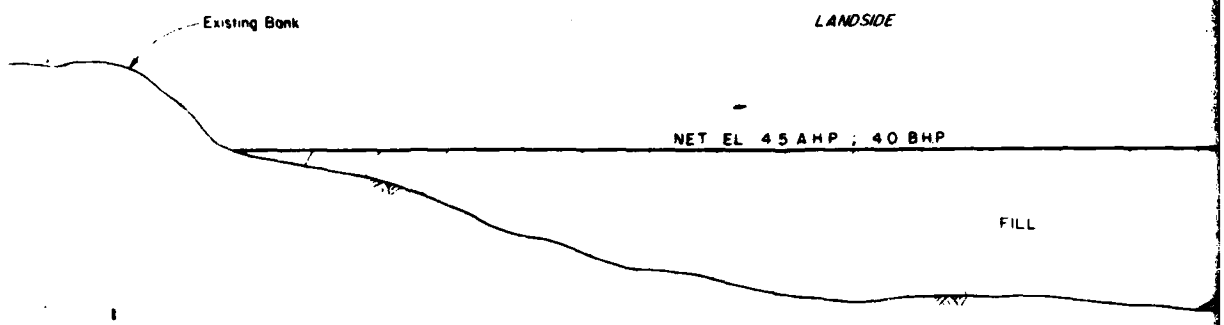
APRIL 1984 FILE NO. [illegible]

PLATE 2

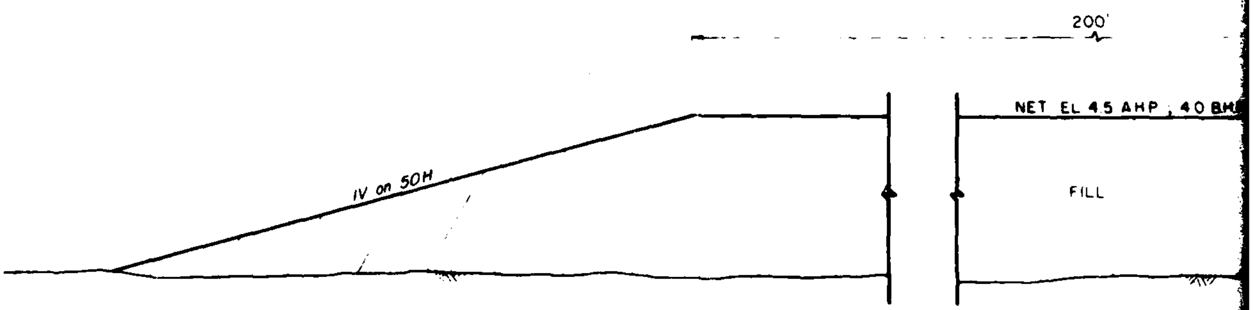

SAFETY IS A PART OF YOUR CONTRACT
EXISTING BANKLINE
BANK NOURISHMENT
ROCK AND SHELL AT NEW OUTLETS ONLY
PLAN VIEW
5'
EL 11.0
1V on 2H
1V on 3H
DIKE
NET EL. 4.5
SECTION A-A
5'
ROCK
EL. 11.0
1V on 2H
1V on 3H
3'
EL. 8.0
SHELL
FILTER FABRIC
SECTION B-B
2H
EL 11.0
ROCK
3H
1V
NET EL. 4.5
SHELL
100' (NEW OUTLETS) SEE PLAN FOR EXISTING OUTLETS
EL. 0.0
ROCK
12" SHELLS
FILTER FABRIC
SECTION C-C


NOTE. EXCAVATE AND CLEAR OUTLET CHANNEL AS REQUIRED
100'
BANKLINE
ROCK AND SHELL AT NEW OUTLETS ONLY
C
BANK NOURISHMENT
PLAN VIEW
200'
NET EL. 4.5
50 H
1 V
BANK NOURISHMENT
SECTION A-A
EL. 11.0
EL. 8.0
TIE-IN DIKE
SHELL
EL. 0.0
ROCK
EL. -3.0
FILTER FABRIC
12" SHELLS
SECTION B-B
EXISTING OUTLETS
EL. 11.0
3H
1V
2H
1V
ROCK
SHELL
NET EL. 4.5
BANK NOURISHMENT
ROCK
FILTER FABRIC
C-C
NOTE
ELEVATIONS REFER TO NGVD
TYPICAL OUTLET SECTIONS

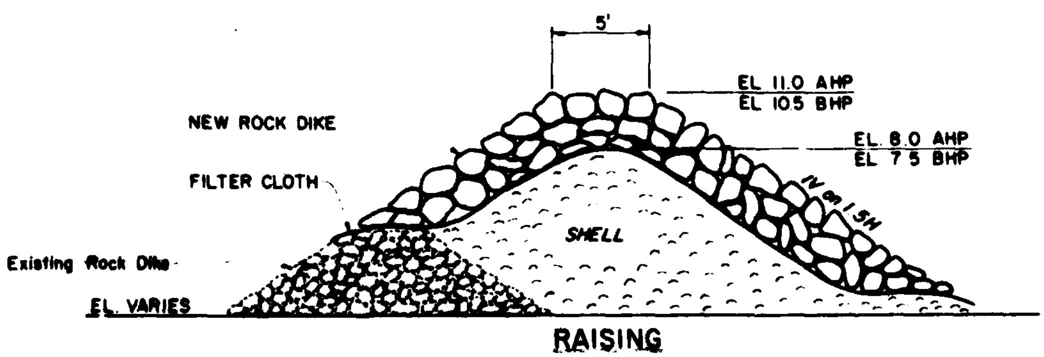
SAFETY IS A PART
OF YOUR CONTRACT



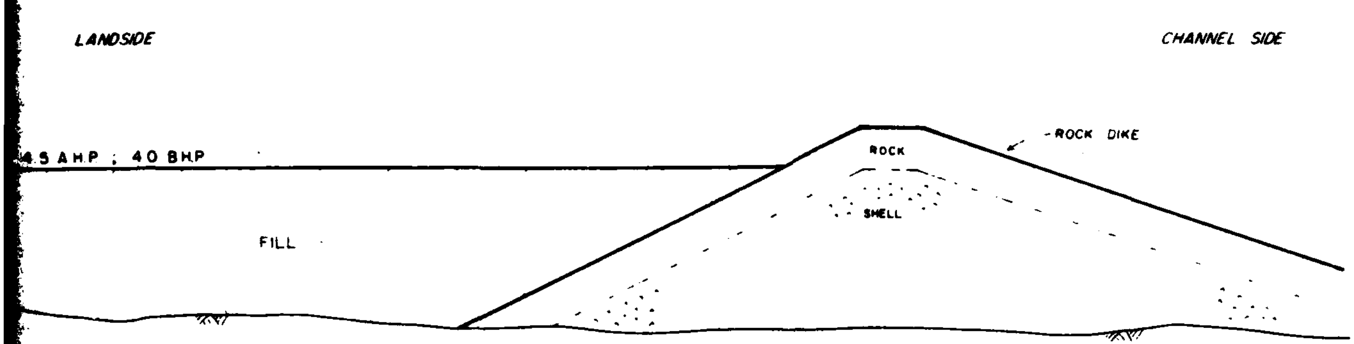

BANK NOURISHM
FOR AREAS WITH EXIST
NTS



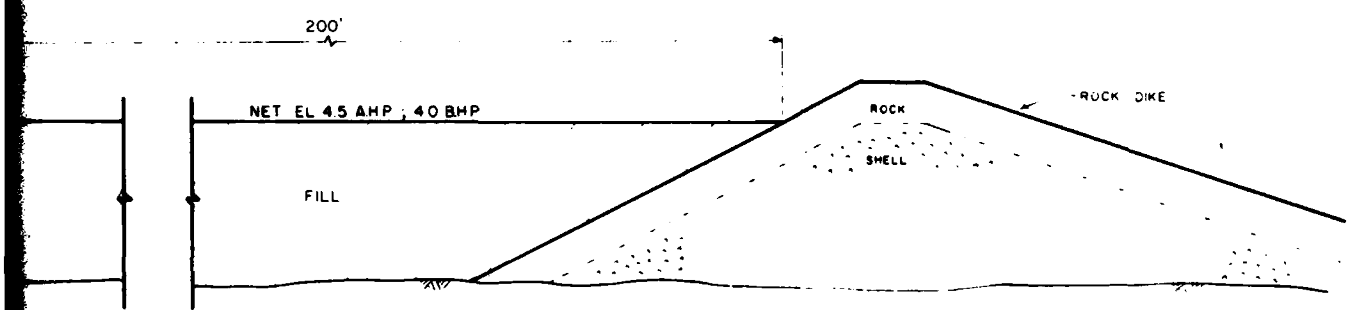

BANK NOURISH
FOR AREAS WITH NO EX
NTS



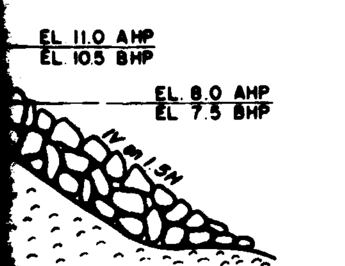

RAISING
EXISTING ROCK DIKE
SCALE




**BANK NOURISHMENT**
**FOR AREAS WITH EXISTING BANK**
NTS




**BANK NOURISHMENT**
**FOR AREAS WITH NO EXISTING BANK**
NTS




KE

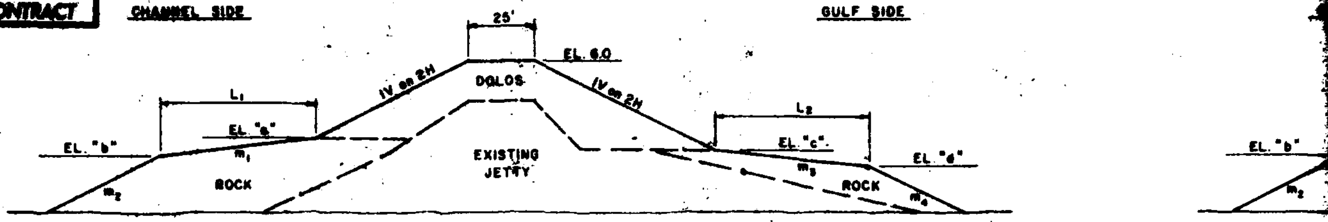
MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO, LA
(SOUTHWEST PASS & BAR CHANNEL)
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT NO 2

BANK NOURISHMENT &
EXISTING DIKE SECTION

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
APRIL 1984

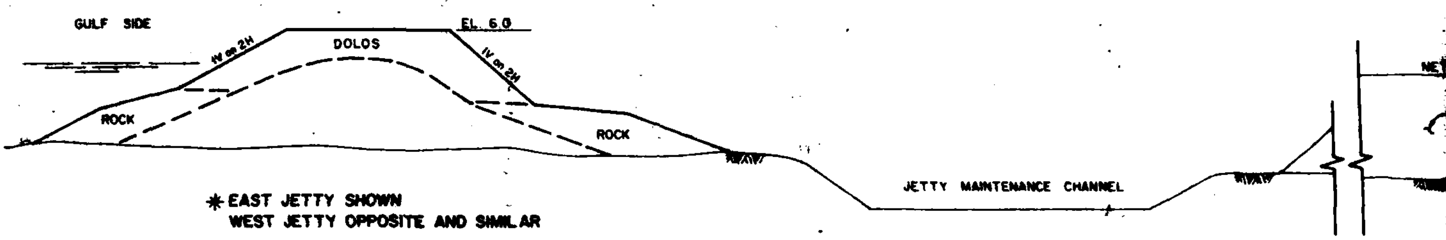
2

**SAFETY IS A PART OF YOUR CONTRACT**




## WEST JETTY SECTION

| REACH | LOCATION STATIONS | ELEVATIONS "a" | "b" | "c" | "d" | SLOPES $M_1$ | $M_2$ | $M_3$ | $M_4$ | LENGTHS $L_1$ | $L_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| W-XI | 934+00-947+00 R-BHP | NO BERM | | | | | | | | | |
| W-XI | 947+00-961+25 R-BHP | -7.0 | -7.0 | -7.0 | -7.0 | Horiz. | 1V on 5.7H | Horiz. | 1V on 6.[illegible]H | 9' | 15' |
| W-XII | 961+25-1029+00 R-BHP | -8.0 | -11.0 | -8.0 | -8.5 | 1V on 13H | 1V on 3H | 1V on 7.5H | 1V on 4H | 39' | 37.5' |
| W-XII | 1029+00-1041+00 R-BHP | -8.0 | -8.5 | -8.0 | -8.5 | 1V on 8.3H | 1V on 4.1H | 1V on 8.3H | 1V on 4.1H | 40' | 40' |

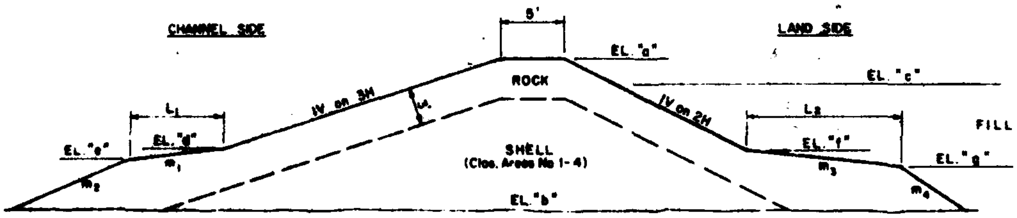



✱ EAST JETTY SHOWN
WEST JETTY OPPOSITE AND SIMILAR

PRESTRESSED CONCRETE
PILE BULKHEAD
36" OUTER DIAMETER
26" INNER DIAMETER

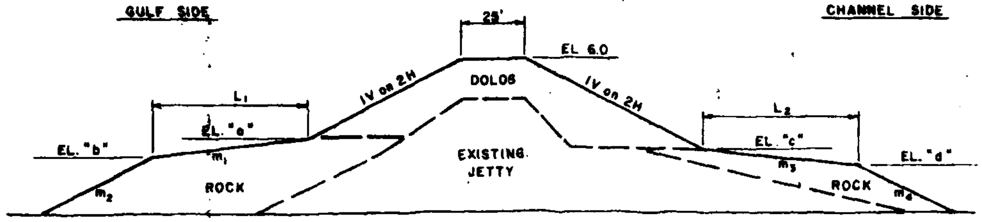
EL.

## INNER EAST AND WEST BULKHEAD



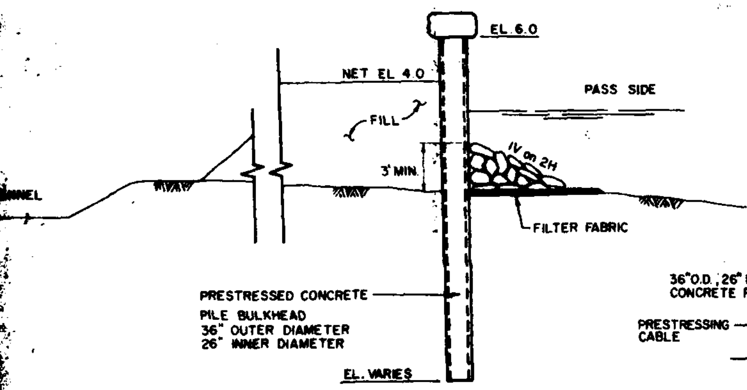

## CLOSURE AREA NO. 1-10

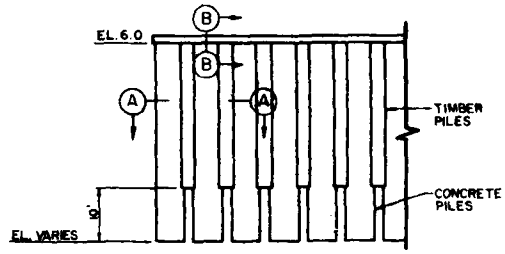
| CLOS. AREA | LOCATION STATIONS | ELEVATIONS "a" | "b" | "c" | "d" | "e" | "f" | "g" | SLOPES $M_1$ | $M_2$ | $M_3$ | $M_4$ | LENGTHS $L_1$ | $L_2$ | ROCK & SHELL | ROCK ONLY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | 10.0 | -1.0 | 7.0 | [illegible] | | | [illegible] | [illegible] | | | | | | ✓ | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | | | [illegible] | [illegible] | | | | | | ✓ | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | – | [illegible] | – | [illegible] | – | [illegible] | – | [illegible] | 0 | 0 | ✓ | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | ✓ | |
| [illegible] | [illegible] | | | | | | | | | | | | | | | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | | ✓ |
| [illegible] | [illegible] | | | | | | | | | | | | | | | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | | ✓ |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | – | [illegible] | [illegible] | [illegible] | – | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | | ✓ |
| [illegible] | [illegible] | | | | | | | | | | | | | | | |



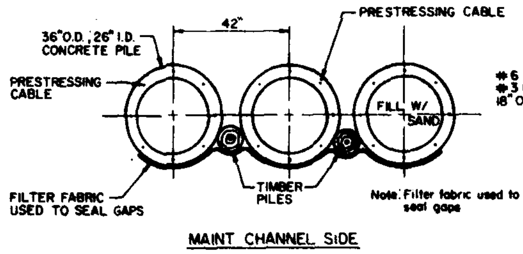

EAST JETTY SECTION

| REACH | LOCATION STATIONS | ELEVATIONS | | | | SLOPES | | | | LENGTHS | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | "a" | "b" | "c" | "d" | $M_1$ | $M_2$ | $M_3$ | $M_4$ | $L_1$ | $L_2$ |
| E-IV | 895+00-981+25 L-BHP | -7.0 | -12.0 | -9.0 | -12.0 | 1V on 11.9H | 1V on 4.4H | 1V on 14.2H | 1V on 3H | 59.5' | 42.6' |
| E-V | 981+25-1043+00L-BHP | -15.0 | -15.0 | -15.0 | -15.0 | Horiz. | 1V on 5.1H | Horiz. | 1V on 5.1H | 38' | 38' |

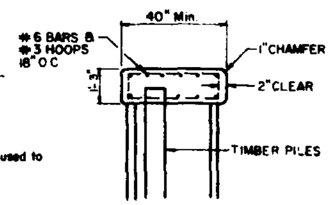



ELEVATION




SECTION A-A




SECTION B-B

ELEVATIONS REFER TO NGVD

NOTE: El "C" Represents an initial fill elevation. The net elevation of fill for all closure areas is El 4.0.

2

MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO, LA
(SOUTHWEST PASS & BAR CHANNEL)
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT NO 2

CLOSURE AREAS, INNER BULKHEAD AND JETTY STABILIZATION

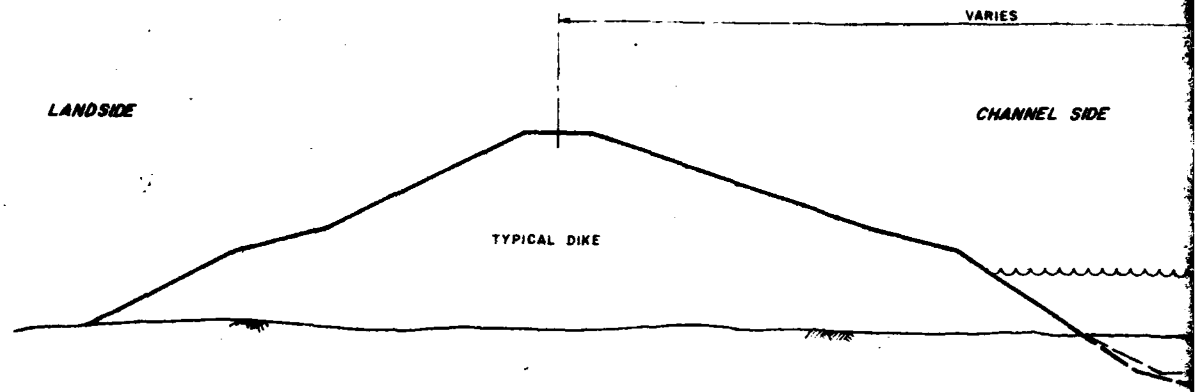
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

APRIL 1984

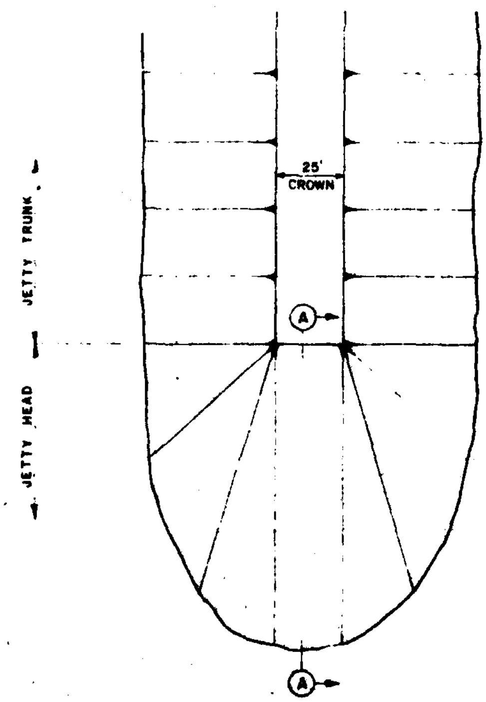
FILE NO H-2-

PLATE 4A

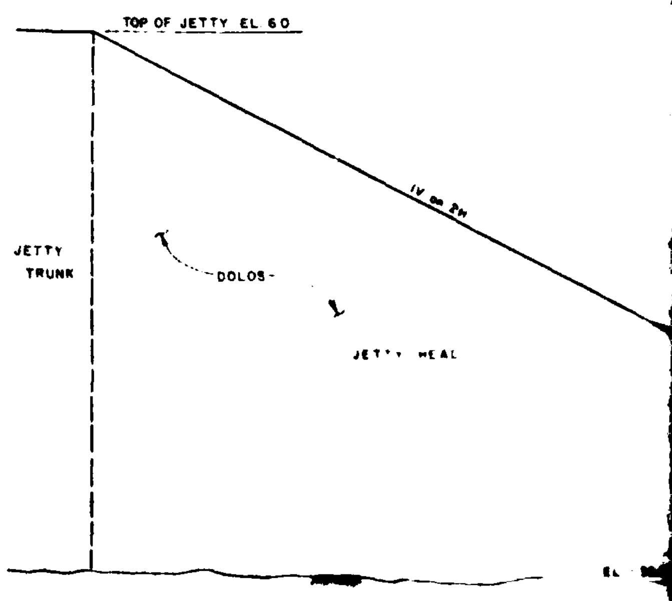
SAFETY IS A PART OF YOUR CONTRACT




FLOATATION CHANNEL
NTS

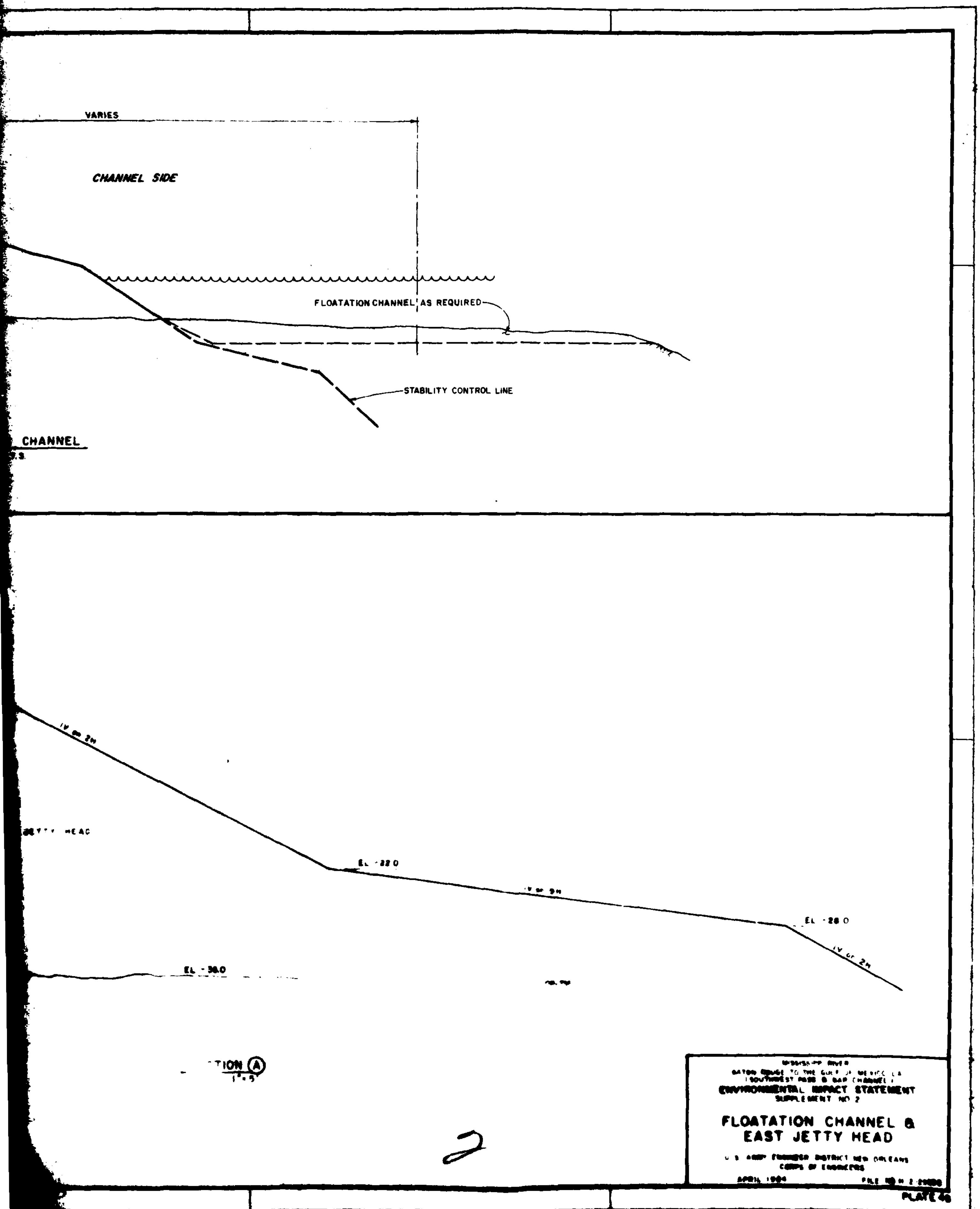



PLAN
SCALE 1"=25'




SECT

EAST JETTY HEAD

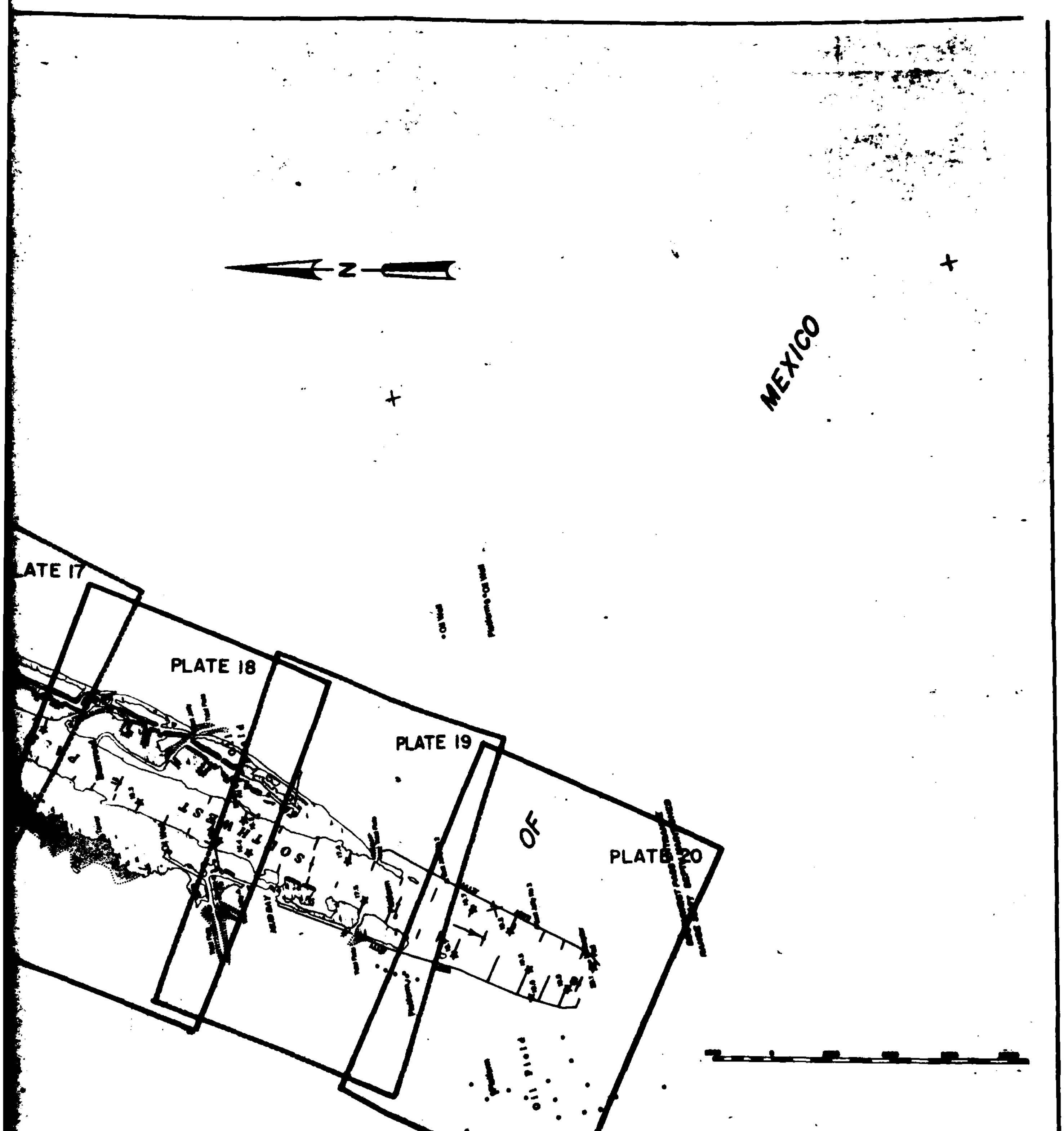

VARIES
CHANNEL SIDE
FLOATATION CHANNEL AS REQUIRED
STABILITY CONTROL LINE
CHANNEL
1V on 2H
EL -22.0
1V on 9H
EL -26.0
1V on 2H
EL -36.0
TION (A)
MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO, LA
(SOUTHWEST PASS & BAR CHANNEL)
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT NO 2
FLOATATION CHANNEL &
EAST JETTY HEAD
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
APRIL 1984
PLATE 46
2

MAIN PASS
PLATE 9
PLATE 8
PLATE 7
PLATE 6
MISSISSIPPI
RIVER
DELTA NATIONAL WILDLIFE REFUGE
CUBITS GAP
GRAND


PLATE 10
PLATE 11
PLATE 12
PLATE 13
RIVER
PASS
RIVERSIDE BAY
Platform
HOSPITAL POND
BOB TAYLORS POND
CHAWEE BAY
GRAND
SCOTT

2


PLATE 14
PLATE 15
PLATE 16
PLATE 17
PLATE 18
PLATE 19
EAST BAY
WEST BAY
SOUTHWEST PASS
N
GULF




MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO LA.
(SOUTHWEST PASS & BAR CHANNEL)

ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT NO. 2

# PLATE INDEX

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

APRIL 1984 FILE NO. H-2-29598


TIGER
PASS

NOTE

EL "±" REPRESENTS AN INITIAL FILL ELEVATION. THE NET ELEVATION OF FILL FOR ALL DIKES IS EL 4.0 BELOW HEAD OF PASS AND EL 4.5 ABOVE HEAD OF PASS

2

## TYPICAL DIKE SECTIONS

U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

APRIL 1984 FILE NO. [illegible]

PLATE 2

MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO, LA
(SOUTHWEST PASS & BAR CHANNEL)
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT NO. 2

## BANK NOURISHMENT PLAN
## MI. 11.6 AHP - 9.2 AHP

2

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

APRIL 1984 FILE NO. H-2-29006

PLATE 6


GRAND PASS
PLAQ
UNITED GAS 6" GASLI


MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO, LA
(SOUTHWEST PASS & BAR CHANNEL)
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT NO 2

BANK NOURISHMENT PLAN
MI. 9.2 AHP – 7.2 AHP

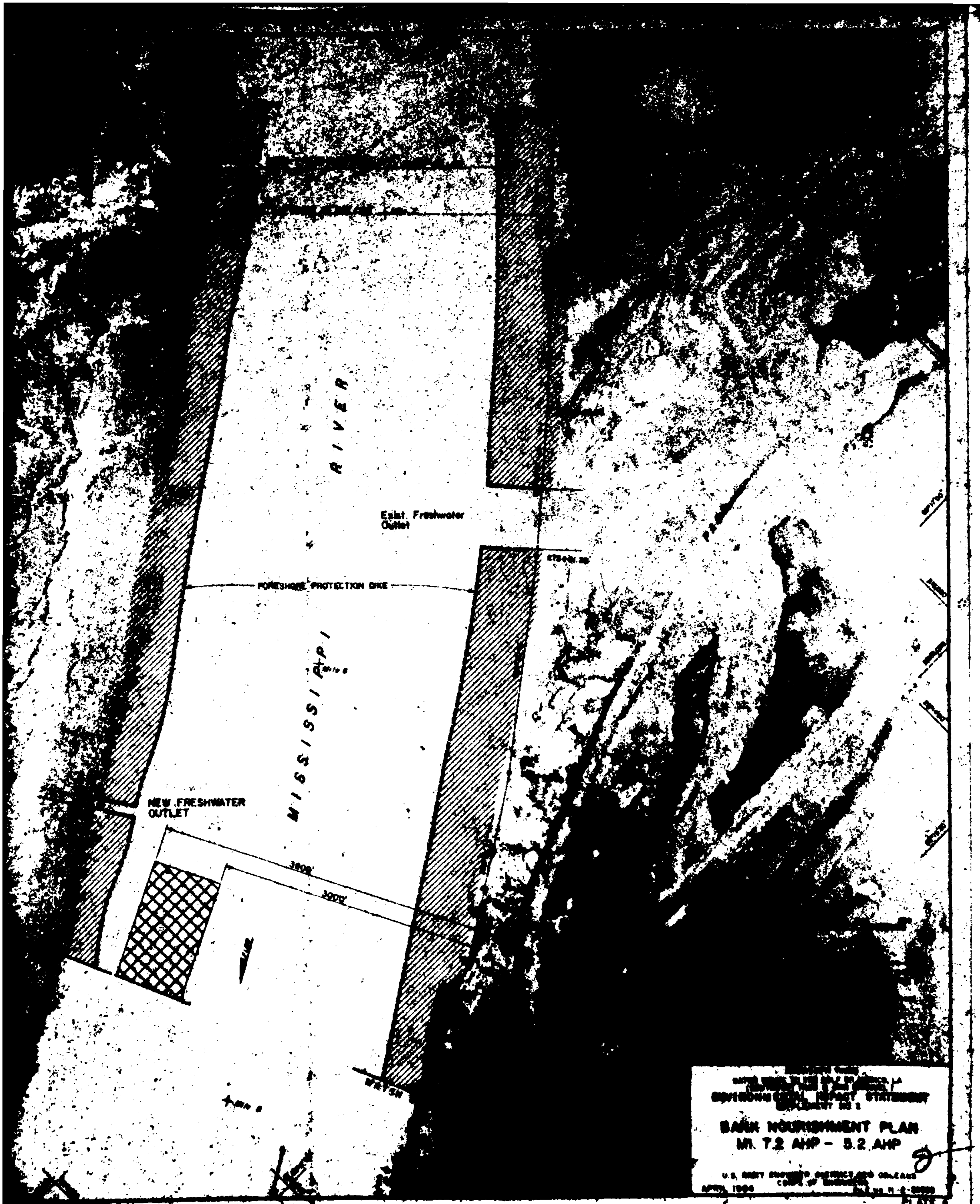
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS

APRIL 1984

FILE NO. H 2-20000

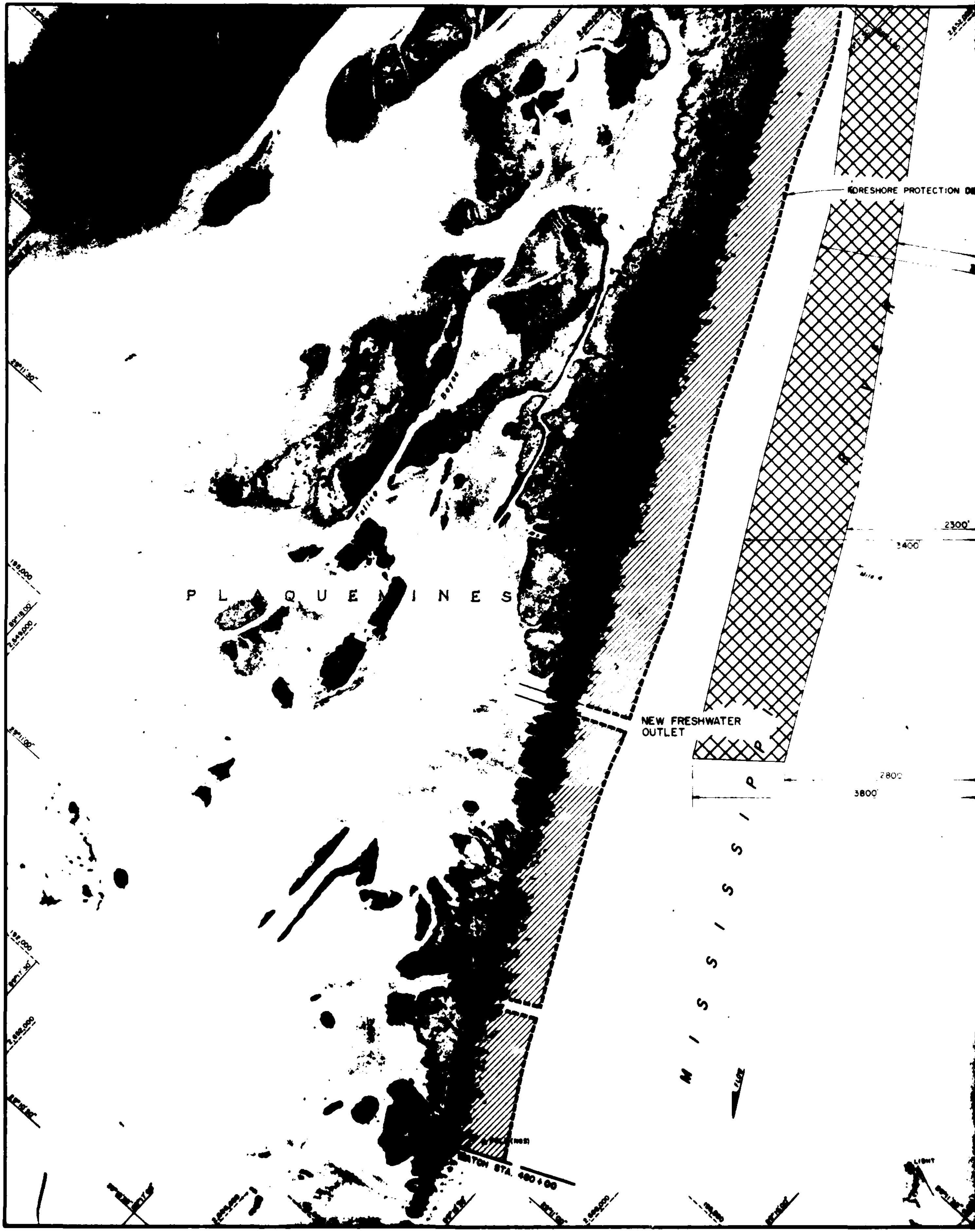
PLATE 7


OUTLET



RIVER
Exist. Freshwater Outlet
FORESHORE PROTECTION DIKE
MISSISSIPPI
NEW FRESHWATER OUTLET
3900'
3000'
ENVIRONMENTAL IMPACT STATEMENT
BANK NOURISHMENT PLAN
MI. 7.2 AHP - 5.2 AHP

PLATE 6


FORESHORE PROTECTION D
NEW FRESHWATER
OUTLET
P L A Q U E M I N E S
M I S S I S S I P P I
2300'
3400'
2800'
3800'
STA. 480+00
LIGHT

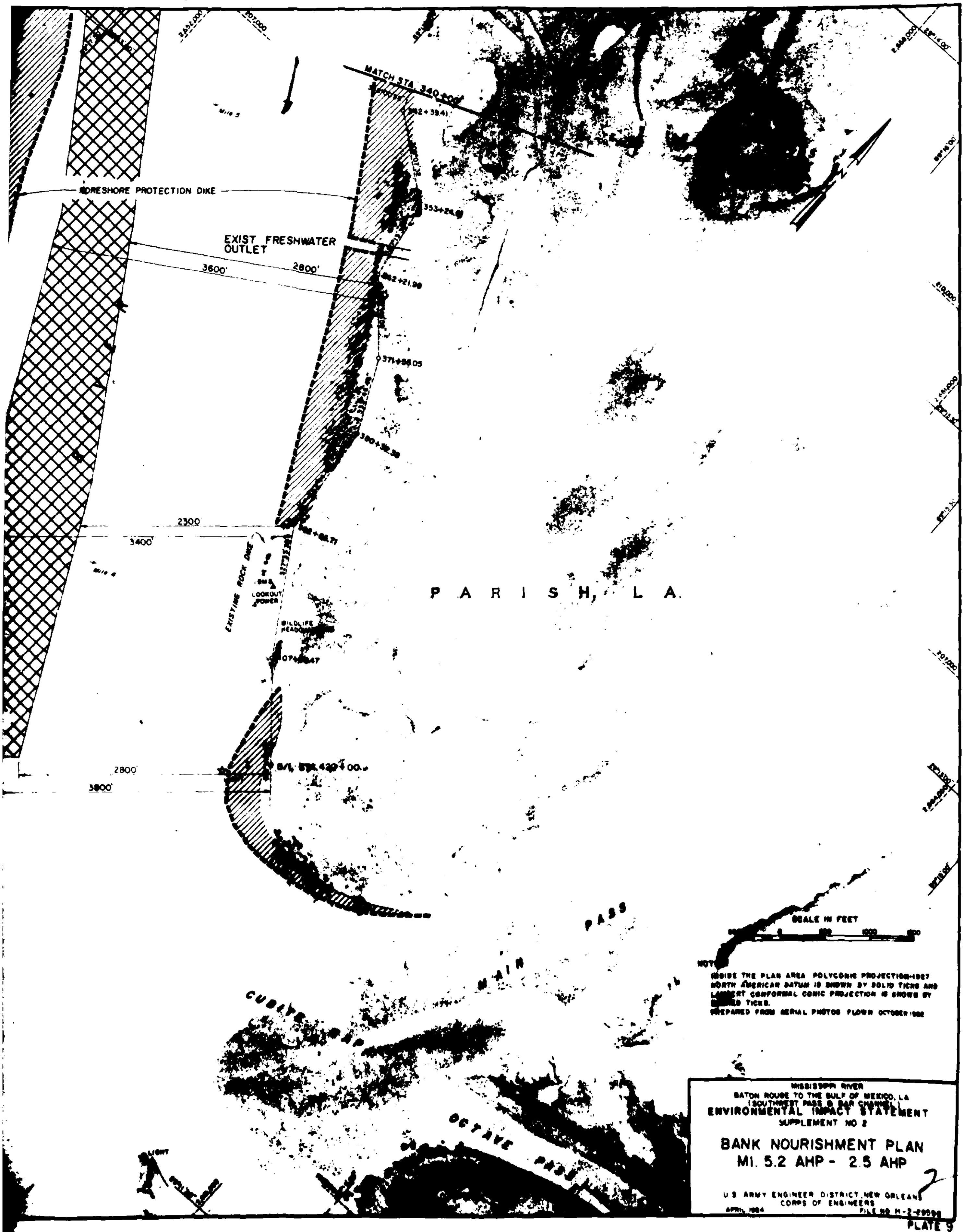

MATCH STA. 340+00
FORESHORE PROTECTION DIKE
EXIST FRESHWATER OUTLET
3600'
2800'
2300'
3400'
2800'
3800'
EXISTING ROCK DIKE
LOOKOUT TOWER
WILDLIFE HEADQ.
PARISH, LA.
MAIN PASS
CUBITS GAP
OCTAVE PASS
SCALE IN FEET
NOTES
INSIDE THE PLAN AREA POLYCONIC PROJECTION-1927 NORTH AMERICAN DATUM IS SHOWN BY SOLID TICKS AND LAMBERT CONFORMAL CONIC PROJECTION IS SHOWN BY DASHED TICKS.
PREPARED FROM AERIAL PHOTOS FLOWN OCTOBER 1982
MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO, LA
(SOUTHWEST PASS & BAR CHANNEL)
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT NO 2
BANK NOURISHMENT PLAN
MI. 5.2 AHP - 2.5 AHP
U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
APRIL 1984

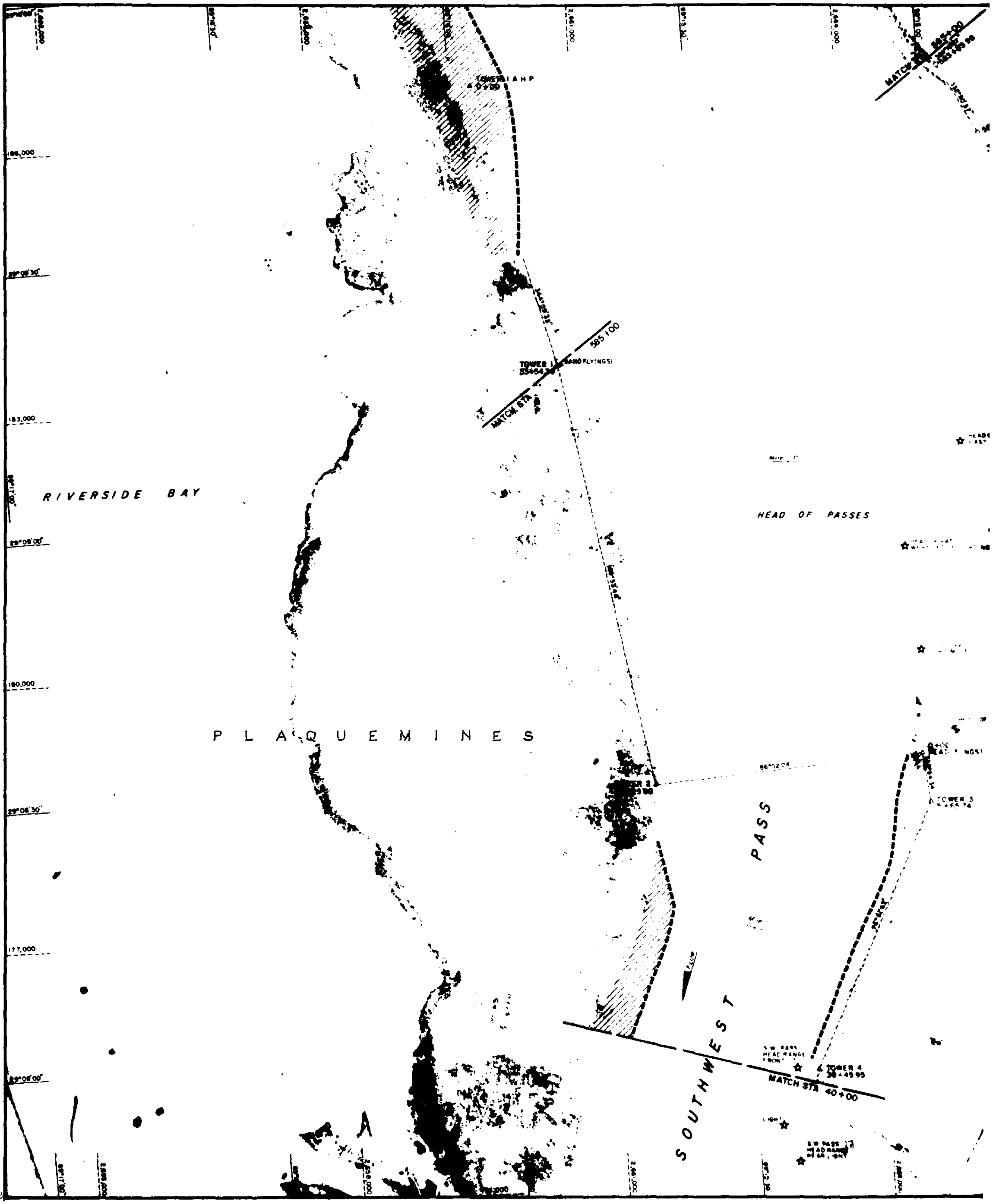
PLATE 9

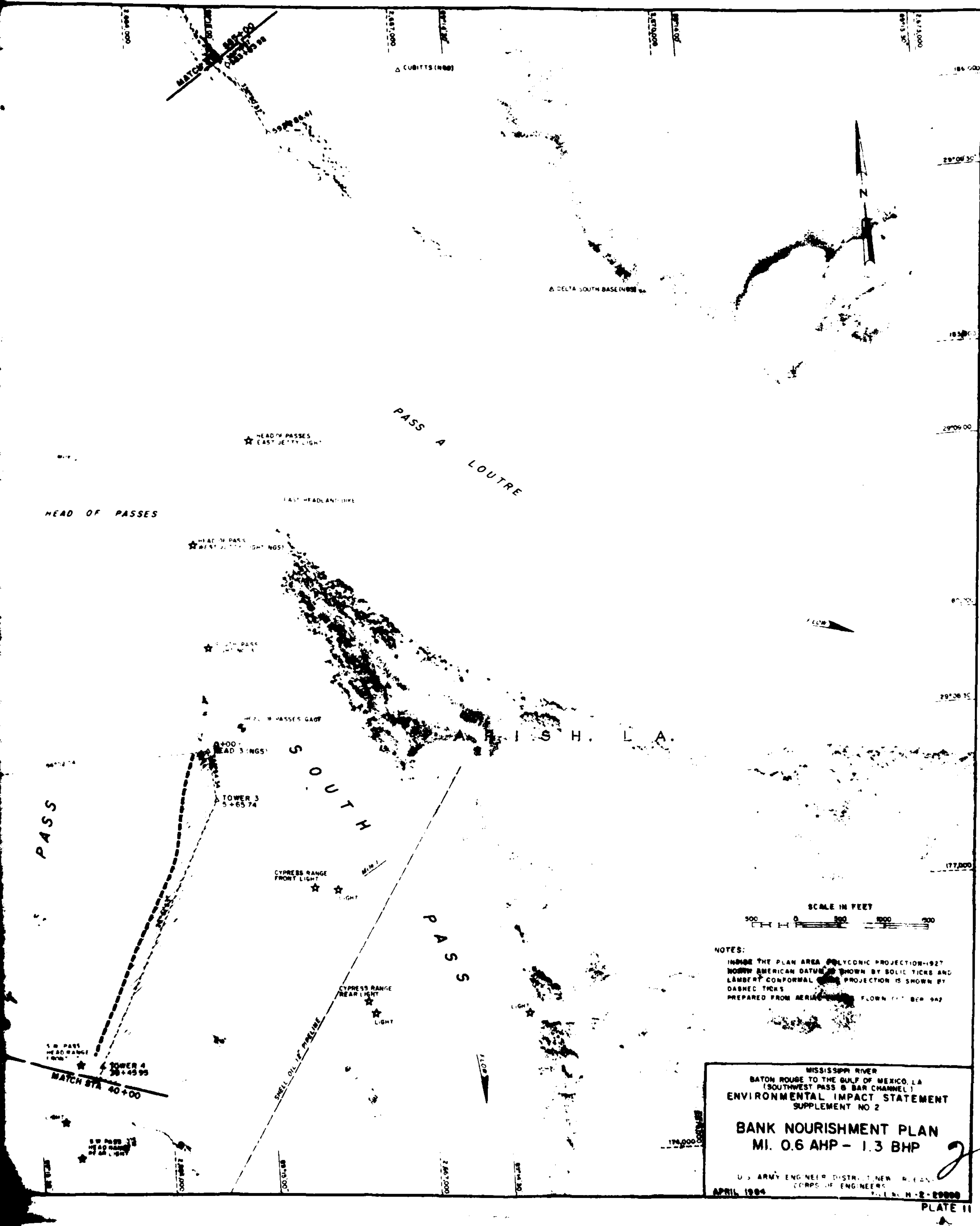

MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO, LA
(SOUTHWEST PASS & BAR CHANNEL)
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT NO. 2

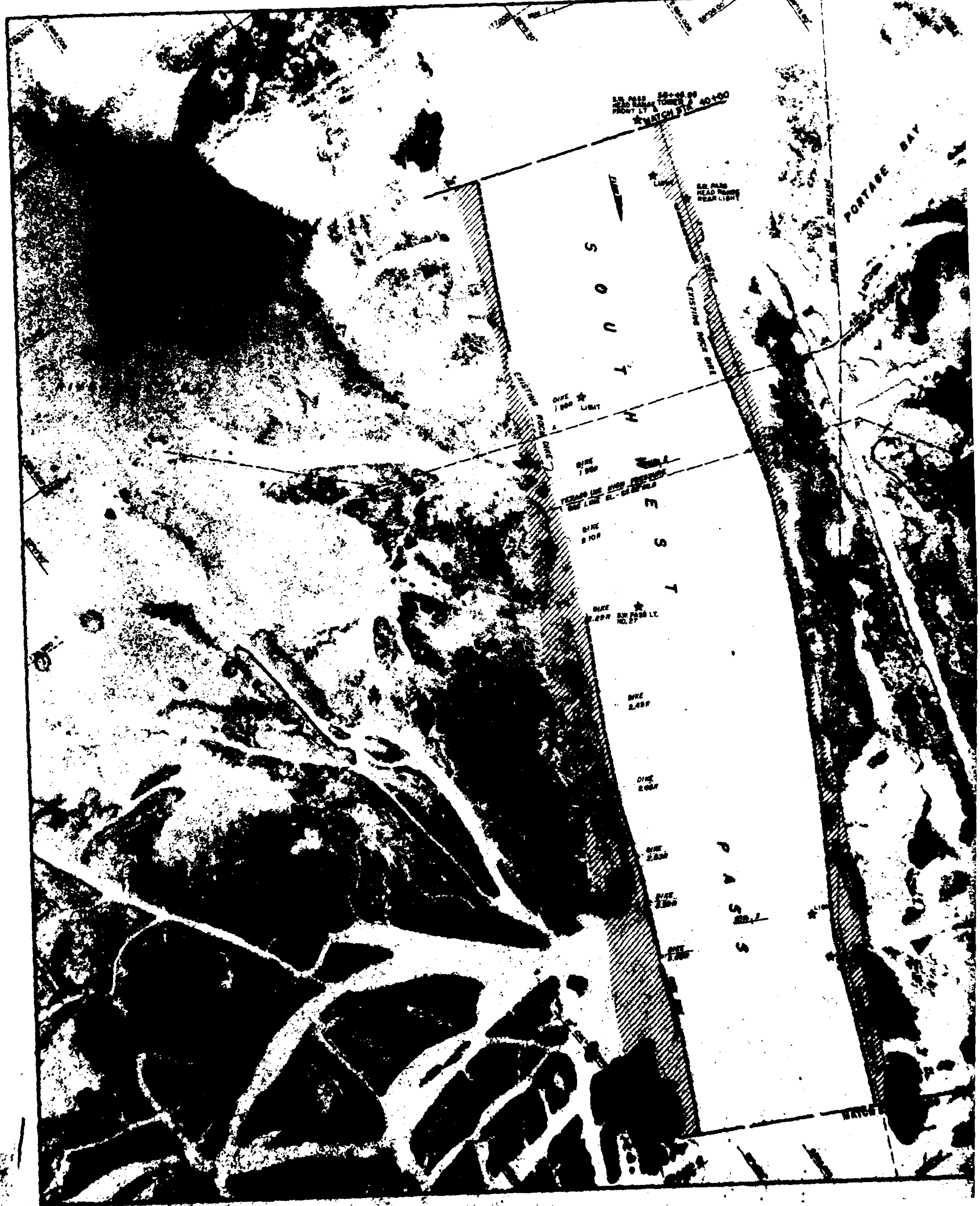
BANK NOURISHMENT PLAN
MI. 2.5 AHP – 0.6 AHP

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
APRIL 1984

PLATE O

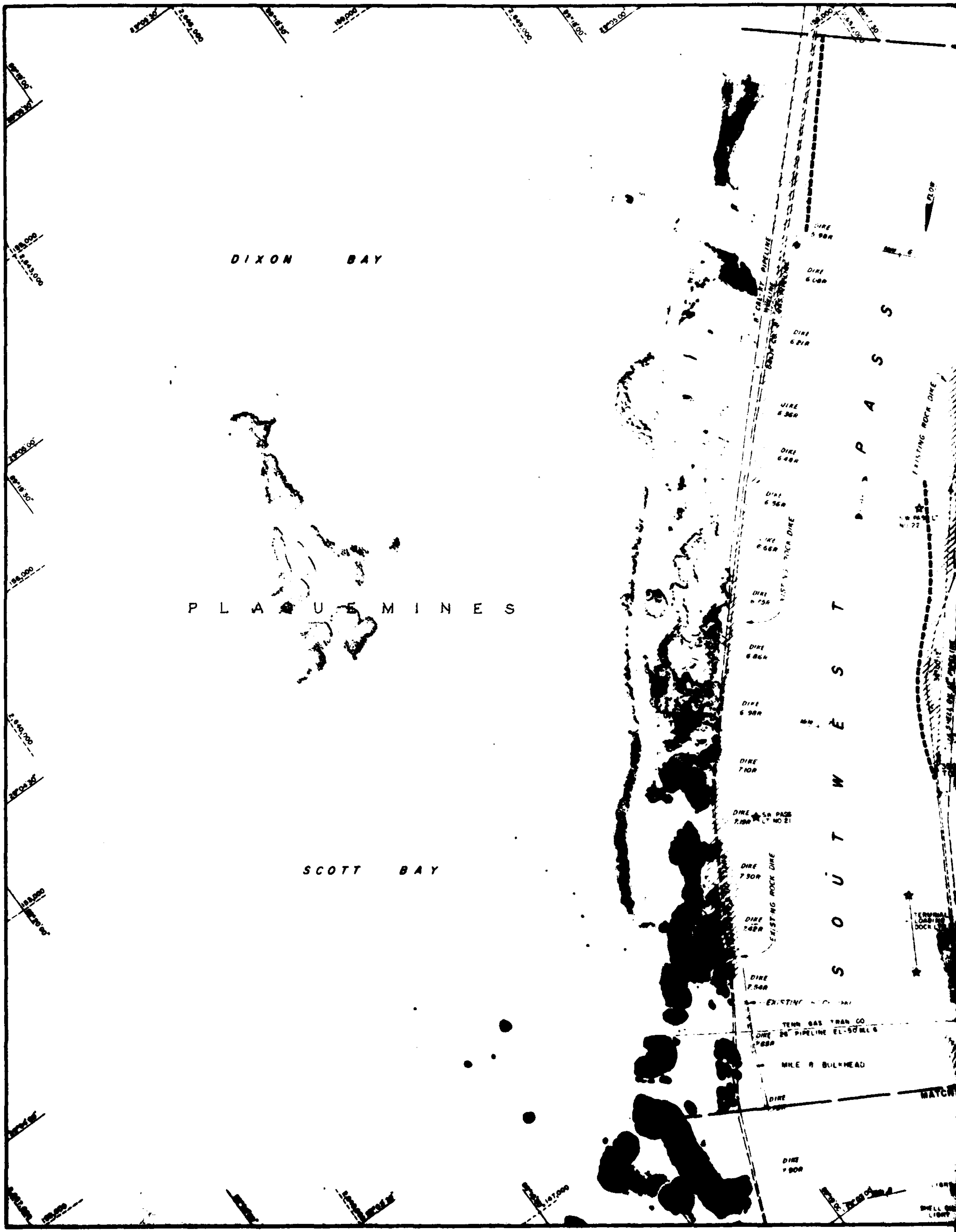

RIVERSIDE BAY
HEAD OF PASSES
PLAQUEMINES
SOUTHWEST PASS
MATCH STA 585+00
MATCH STA 40+00
TOWER 4
186,000
183,000
180,000
177,000
29°08'30"
29°08'00"

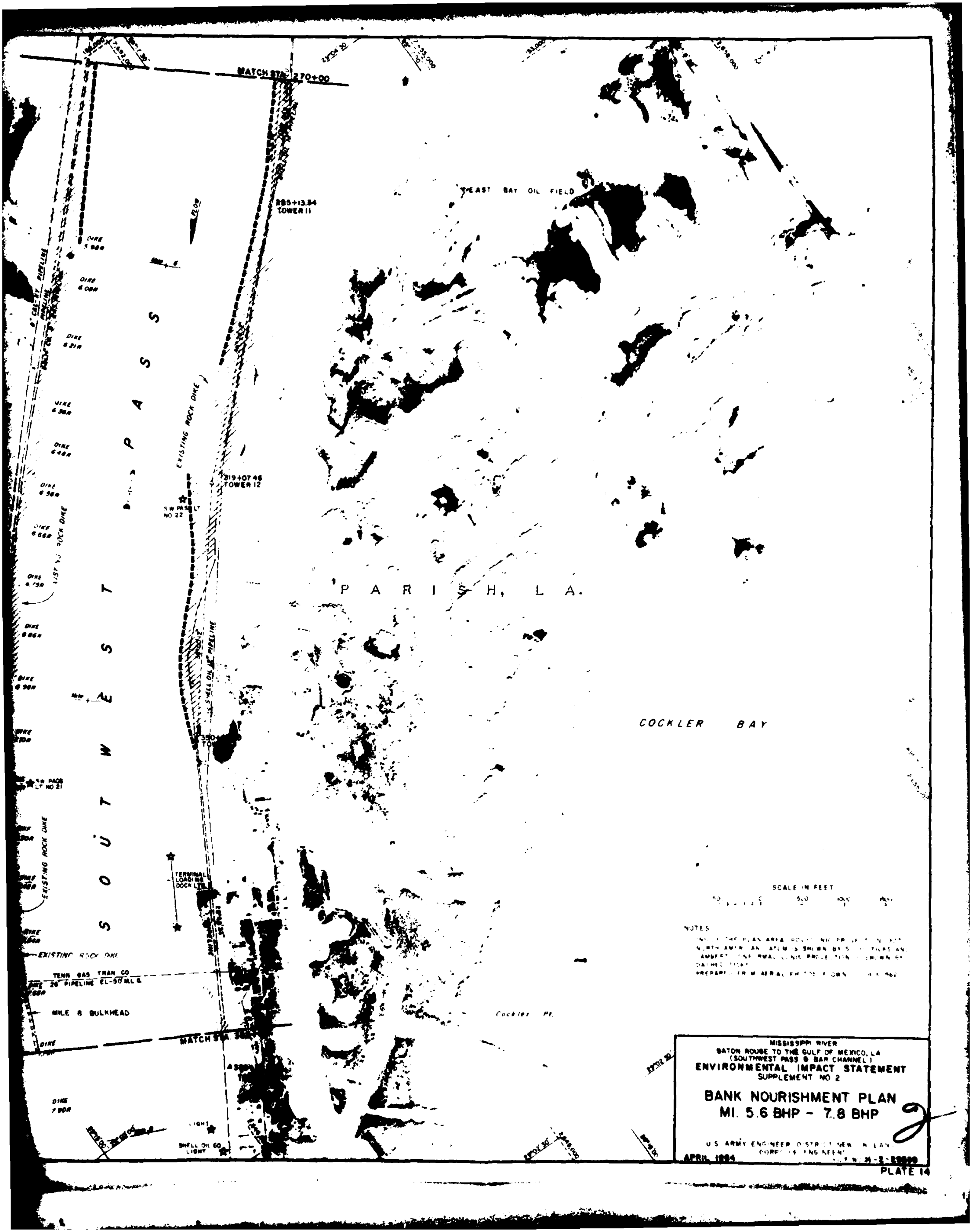

PASS A LOUTRE
HEAD OF PASSES
SOUTH PASS
PASS
CUBITTS (NGS)
DELTA SOUTH BASE (NGS)
HEAD OF PASSES EAST JETTY LIGHT
EAST HEADLAND DIKE
TOWER 3
5+65.74
TOWER 4
CYPRESS RANGE FRONT LIGHT
CYPRESS RANGE REAR LIGHT
LIGHT
SHELL OIL 12" PIPELINE
MATCH STA 40+00
FLOW
N
SCALE IN FEET
NOTES:
MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO, LA
(SOUTHWEST PASS & BAR CHANNEL)
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT NO 2
BANK NOURISHMENT PLAN
MI. 0.6 AHP - 1.3 BHP
APRIL 1984
PLATE 11

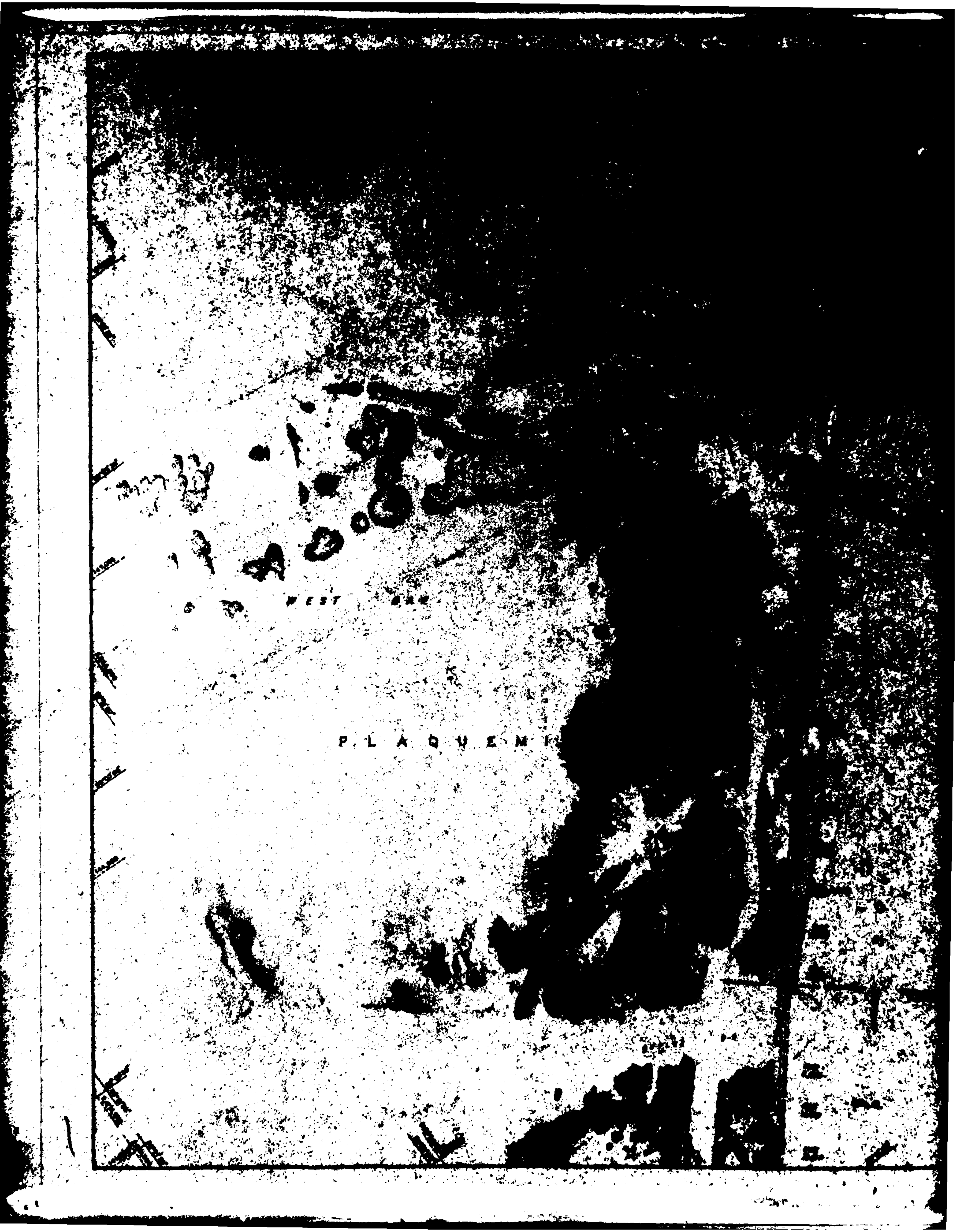

S O U T H W E S T
P A S S
PORTAGE BAY
EXISTING ROCK DIKE
EXISTING ROCK DIKE


PORTAGE BAY
PASS
ENVIRONMENTAL IMPACT STATEMENT
BANK NOURISHMENT PLAN
MI. 1.3 BHP - 3.4 BHP
APRIL 1984

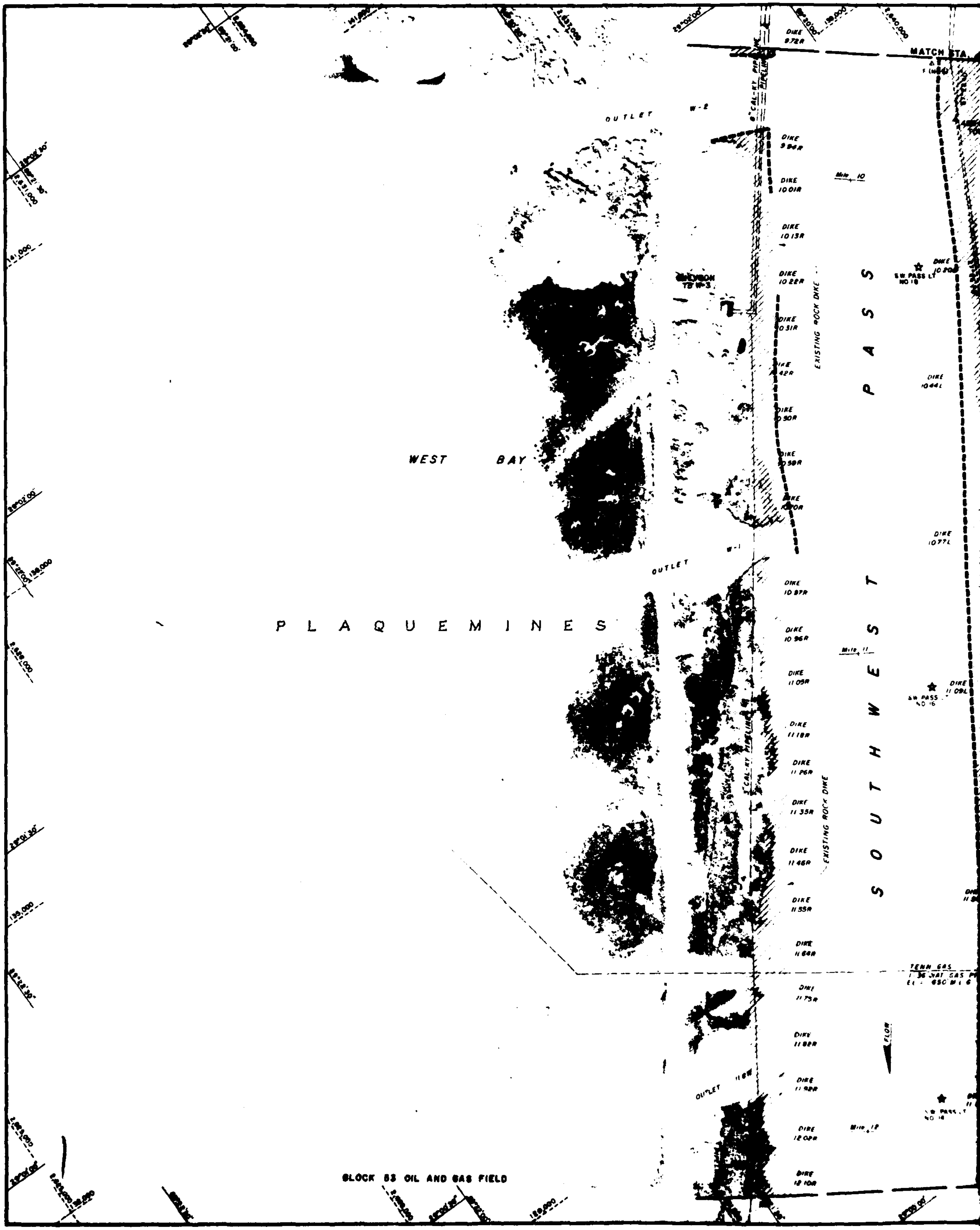
PASS
A.
ENVIRONMENTAL IMPACT STATEMENT
PLAN
APRIL 19
PLATE 1

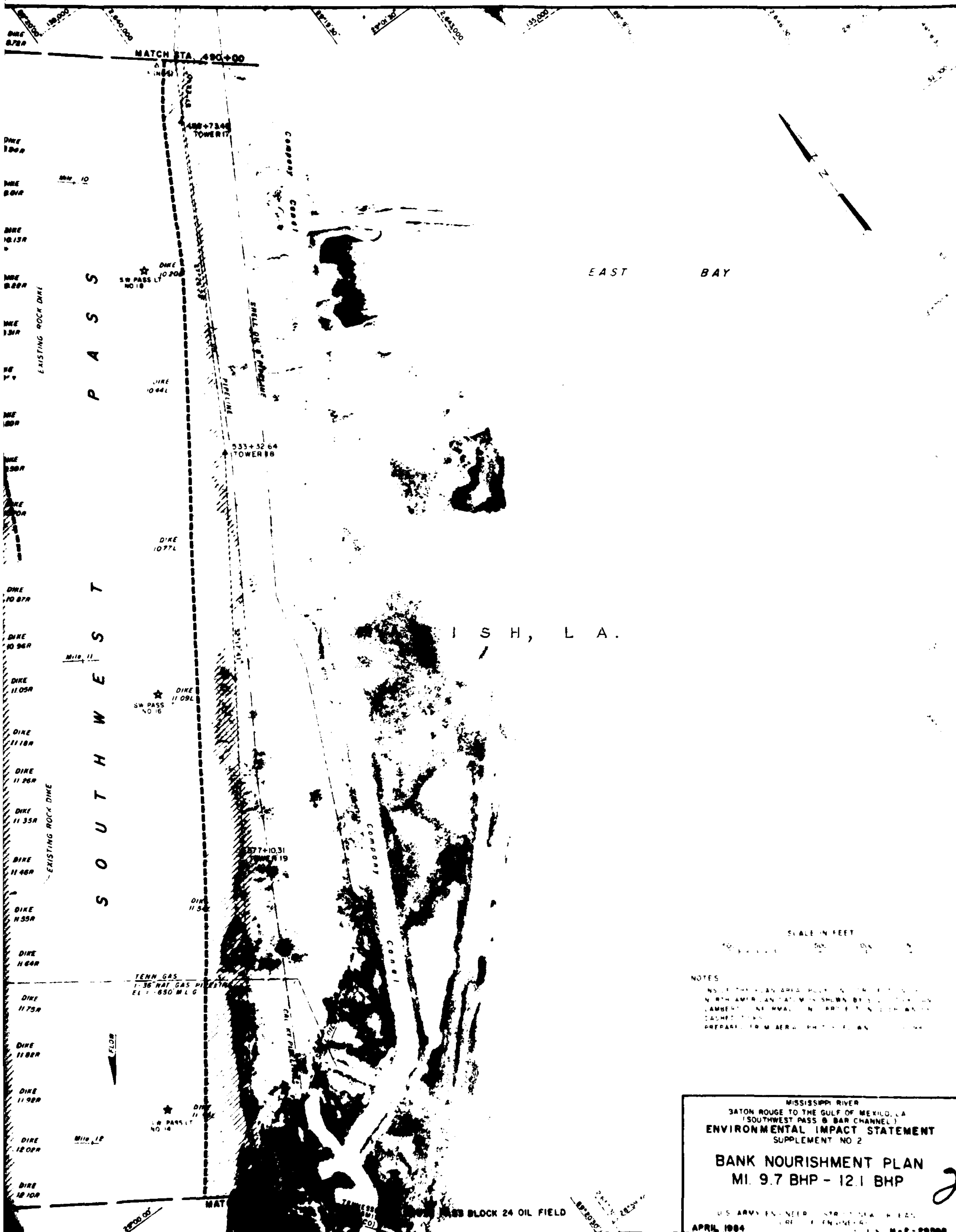

DIXON BAY
PLAQUEMINES
SCOTT BAY
SOUTHWEST PASS
EXISTING ROCK DIKE
DIKE 5.98R
DIKE 6.08R
DIKE 6.21R
DIKE 6.36R
DIKE 6.48R
DIKE 6.56R
DIKE 6.86R
DIKE 6.98R
DIKE 7.10R
DIKE 7.18R
SW PASS LT NO 21
DIKE 7.30R
DIKE 7.42R
DIKE 7.54R
TENN GAS TRAN CO
MILE 8 BULKHEAD
DIKE 7.90R


MATCH STA 270+00
EAST BAY OIL FIELD
295+13.84 TOWER 11
319+07.46 TOWER 12
S W PASS LT NO 22
EXISTING ROCK DIKE
S O U T H W E S T P A S S
P A R I S H, L A.
COCKLER BAY
Cockler Pt.
SHELL OIL 10" PIPELINE
S W PASS LT NO 21
TERMINAL LOADING DOCK LTS
EXISTING ROCK DIKE
TENN GAS TRAN CO
26" PIPELINE EL-50 MLG
MILE 8 BULKHEAD
LIGHT
SHELL OIL CO LIGHT
SCALE IN FEET
NOTES
MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO, LA
(SOUTHWEST PASS & BAR CHANNEL)
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT NO 2
BANK NOURISHMENT PLAN
MI. 5.6 BHP - 7.8 BHP
APRIL 1984
PLATE 14



WEST
P L A Q U E M


MATCH STA.
OUTLET W-2
DIKE 9.72R
DIKE 9.94R
DIKE 10.01R
DIKE 10.13R
DIKE 10.22R
DIKE 10.31R
DIKE 10.50R
DIKE 10.58R
DIKE 10.87R
DIKE 10.96R
DIKE 11.09R
DIKE 11.18R
DIKE 11.26R
DIKE 11.35R
DIKE 11.46R
DIKE 11.55R
DIKE 11.64R
DIKE 11.75R
DIKE 11.82R
DIKE 11.92R
DIKE 12.02R
DIKE 12.10R
DIKE 10.44L
DIKE 10.77L
DIKE 11.09L
Mile 10
Mile 11
Mile 12
EXISTING ROCK DIKE
OUTLET W-1
OUTLET
WEST BAY
P L A Q U E M I N E S
S O U T H W E S T P A S S
FLOW
TENN GAS
BLOCK 53 OIL AND GAS FIELD




MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO, LA
(SOUTHWEST PASS & BAR CHANNEL)
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT NO 2

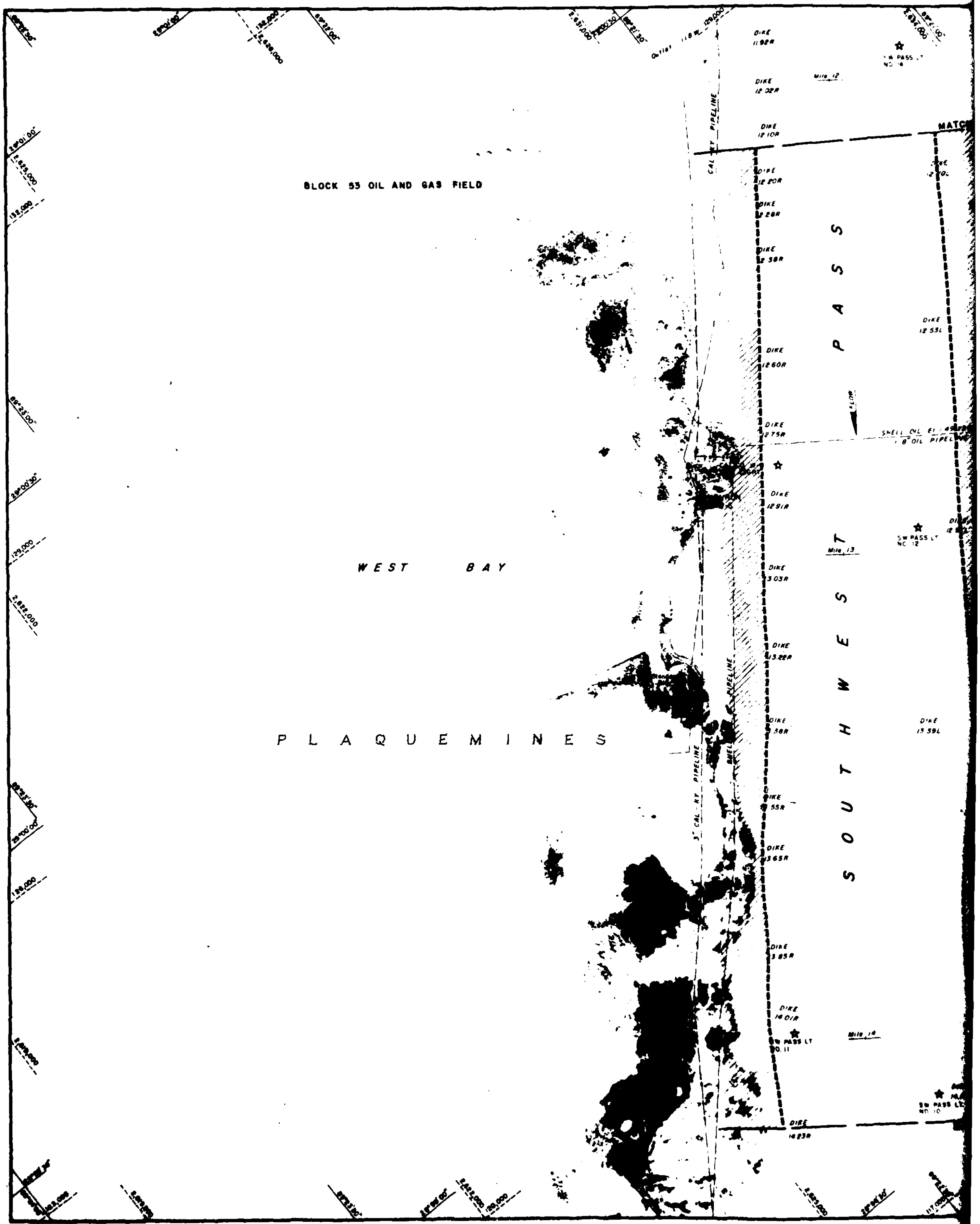
BANK NOURISHMENT PLAN
MI. 9.7 BHP - 12.1 BHP

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

APRIL 1984

H-2-29998

PLATE 16


BLOCK 53 OIL AND GAS FIELD
WEST BAY
PLAQUEMINES
SOUTHWEST PASS
DIKE 11.92R
DIKE 12.02R
DIKE 12.10R
DIKE 12.20R
DIKE 12.28R
DIKE 12.38R
DIKE 12.60R
DIKE 12.75R
DIKE 12.91R
DIKE 13.03R
DIKE 13.22R
DIKE 13.65R
DIKE 14.01R
DIKE 14.23R
DIKE 12.53L
DIKE 13.59L
SW PASS LT NO 14
SW PASS LT NO 12
SW PASS LT NO. 11
SW PASS LT NO 10
Mile 12
Mile 13
Mile 14
FLOW
SHELL OIL
8" OIL PIPELINE
PIPELINE
3" CAL-KY PIPELINE
MATCH

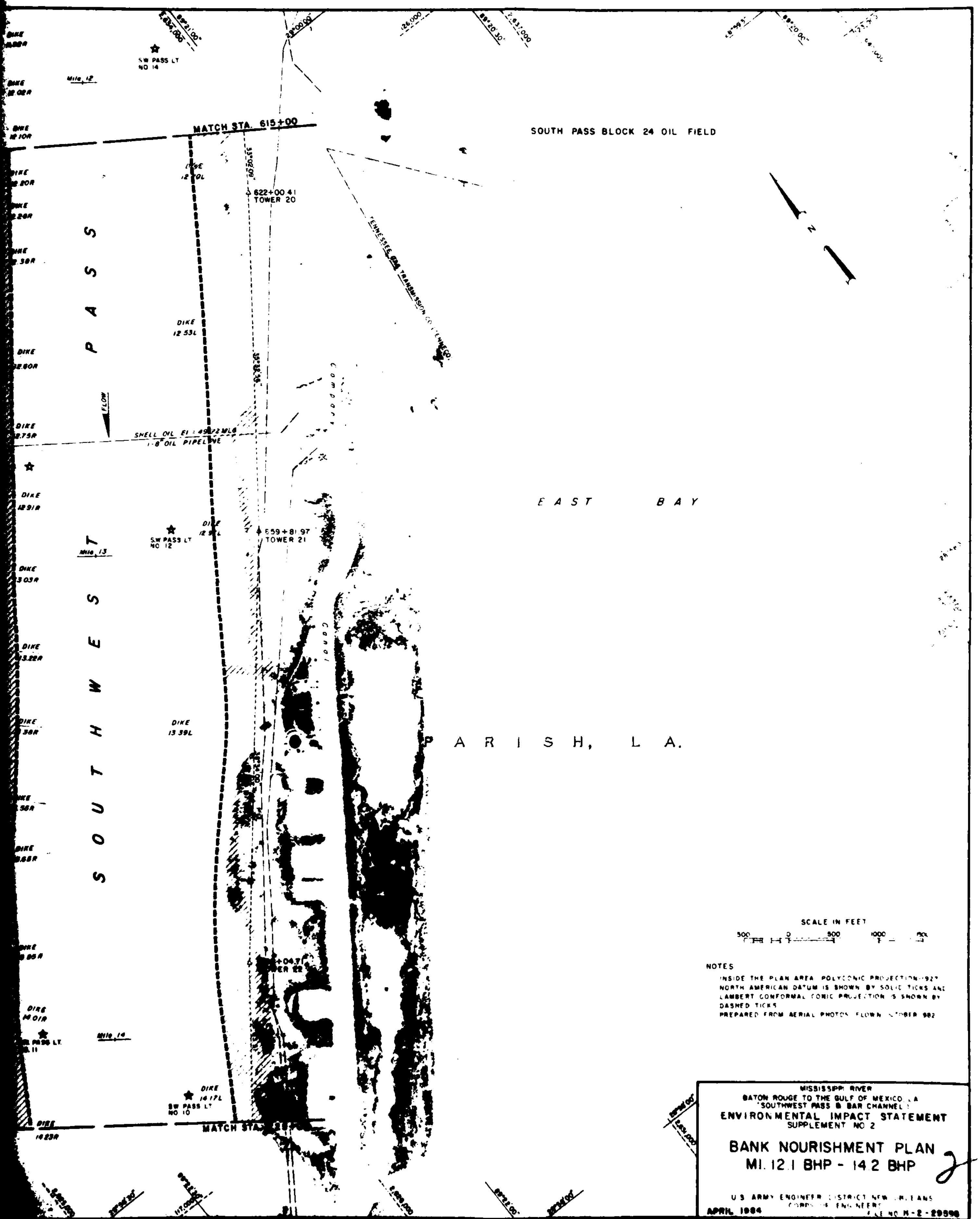
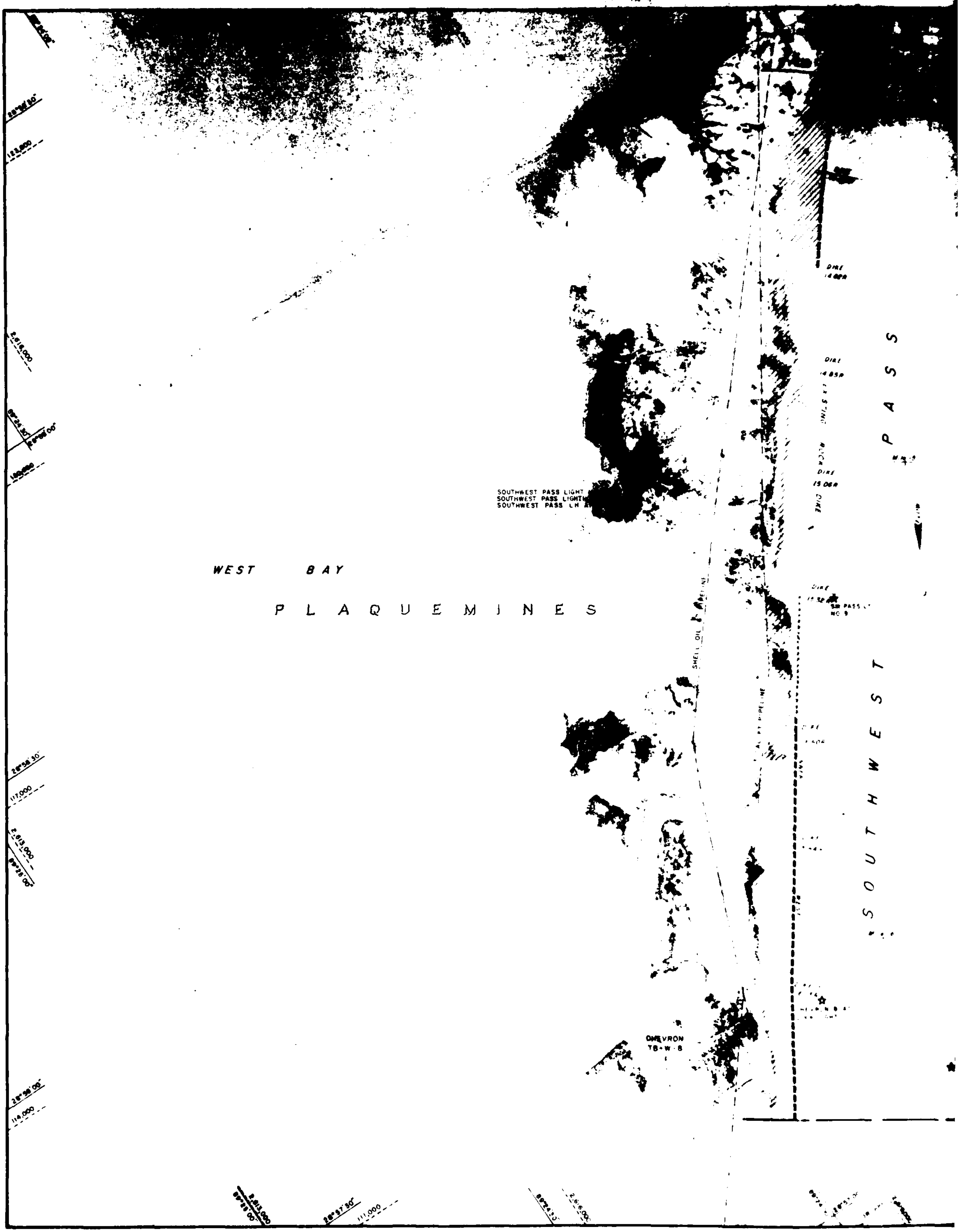
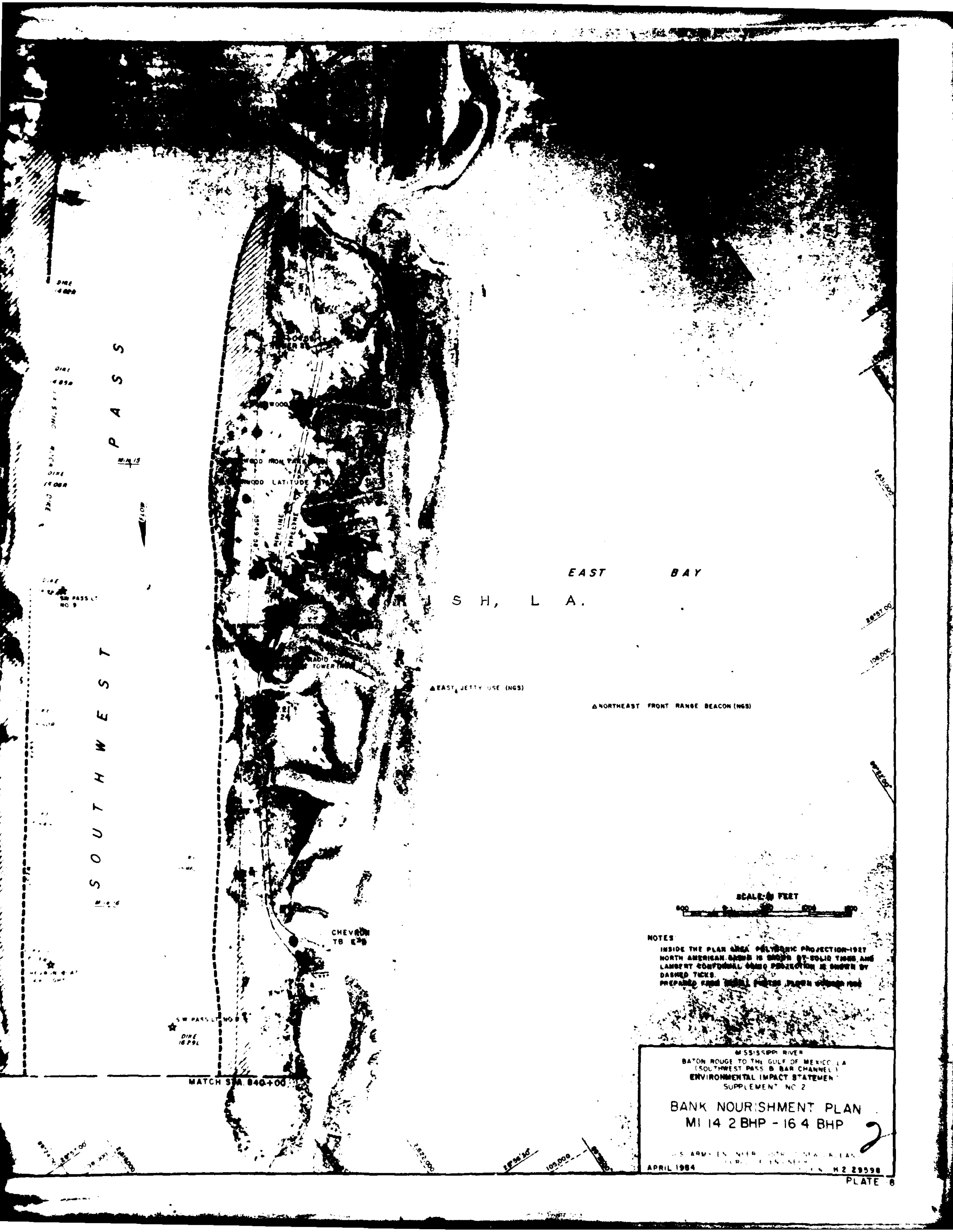
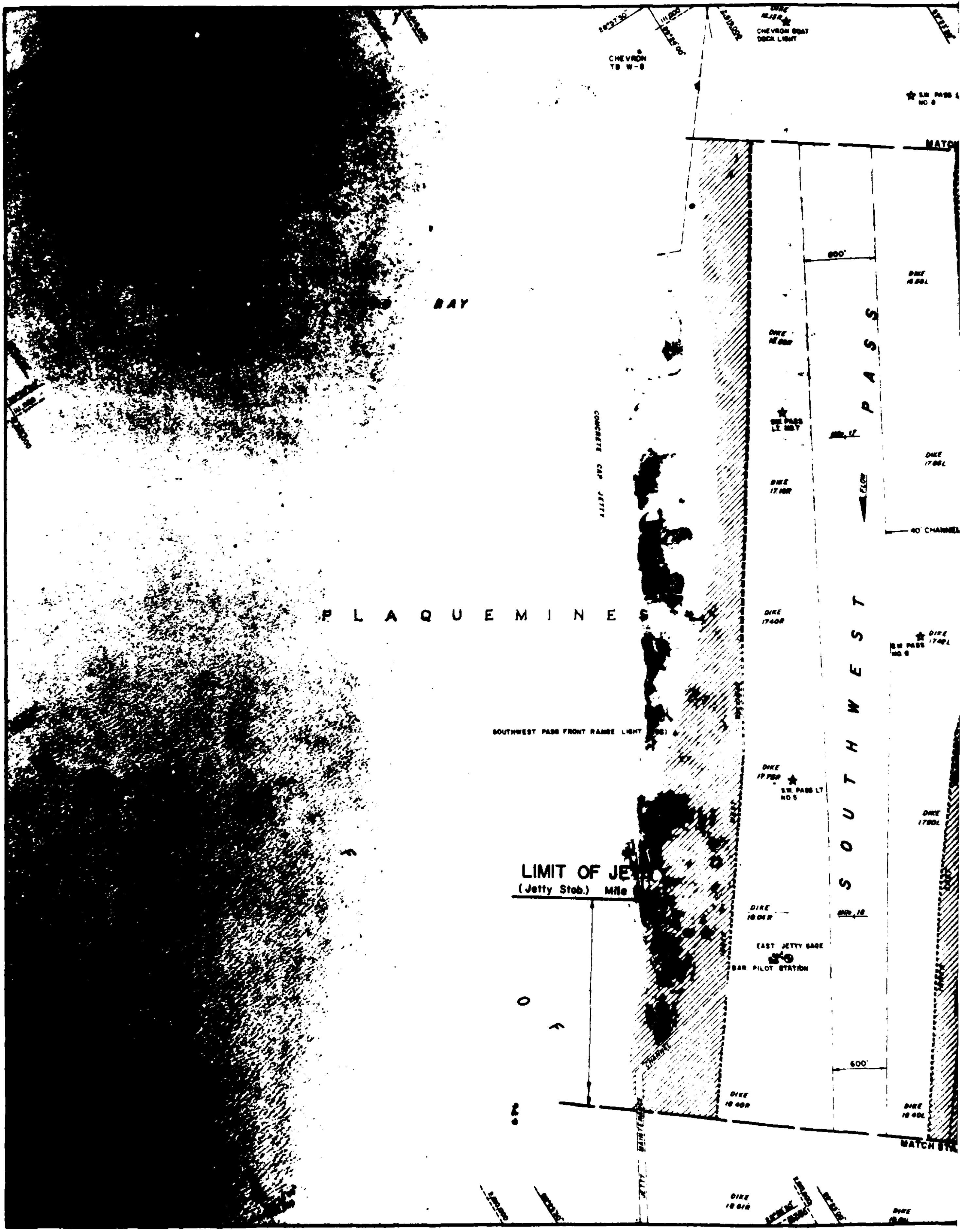

MATCH STA. 615+00
SOUTH PASS BLOCK 24 OIL FIELD
622+00.41
TOWER 20
SW PASS LT
NO 14
Mile 12
TENNESSEE GAS TRANSMISSION CO.
DIKE
12.53L
FLOW
SHELL OIL EL: 49.72 MLG
1-8" OIL PIPELINE
EAST BAY
659+81.97
TOWER 21
SW PASS LT
NO 12
Mile 13
DIKE
13.39L
SOUTHWEST PASS
PARISH, LA.
Mile 14
DIKE
14.17L
SW PASS LT
NO 10
MATCH STA.
SCALE IN FEET
NOTES
INSIDE THE PLAN AREA POLYCONIC PROJECTION 1927 NORTH AMERICAN DATUM IS SHOWN BY SOLID TICKS AND LAMBERT CONFORMAL CONIC PROJECTION IS SHOWN BY DASHED TICKS
PREPARED FROM AERIAL PHOTOS FLOWN OCTOBER 982
MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO, LA
(SOUTHWEST PASS & BAR CHANNEL)
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT NO 2
BANK NOURISHMENT PLAN
MI. 12.1 BHP - 14.2 BHP
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
APRIL 1984
FILE NO H-2-29598

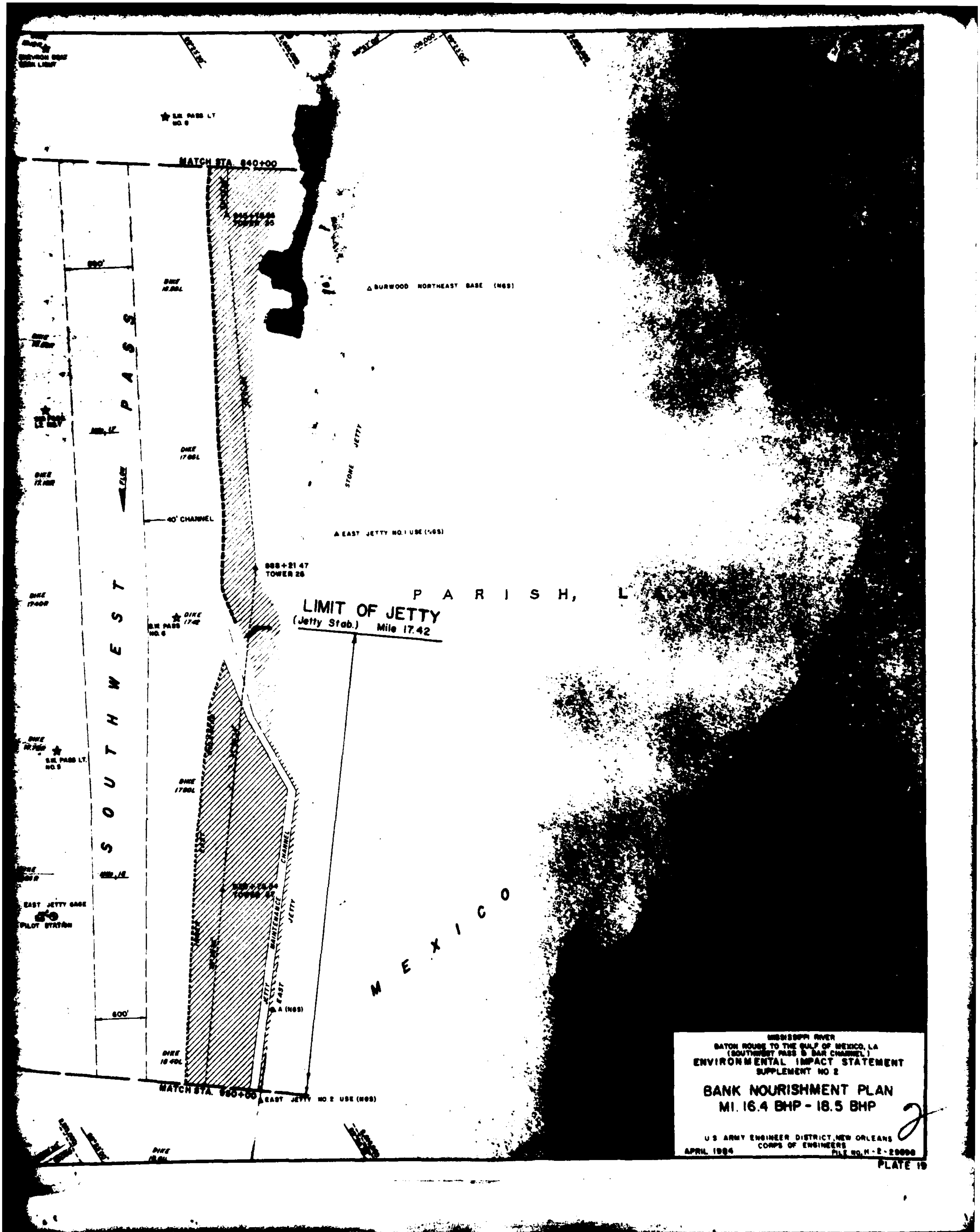
PLATE 17

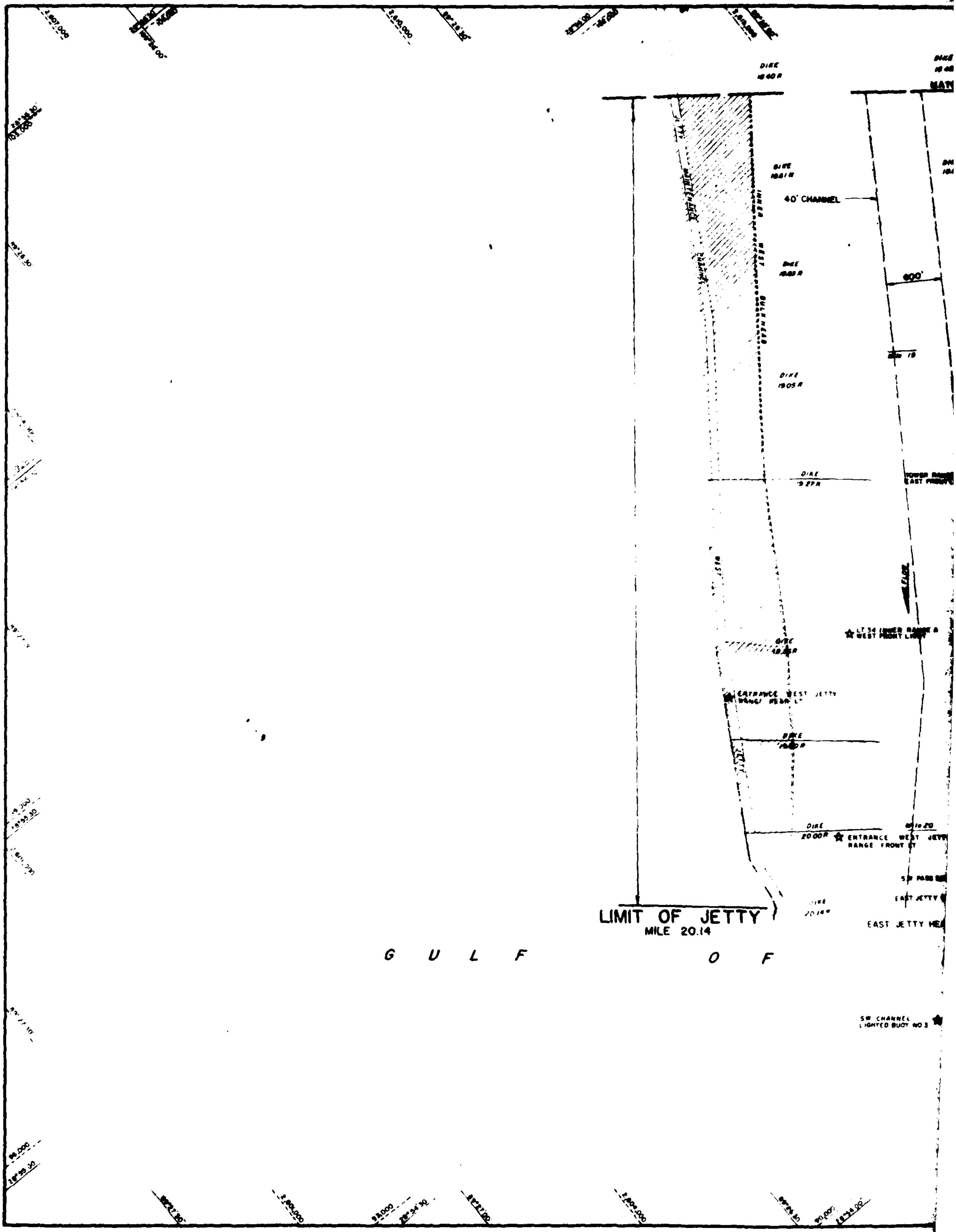


SOUTHWEST PASS LIGHT
SOUTHWEST PASS LIGHT
SOUTHWEST PASS LH
WEST BAY
PLAQUEMINES
SOUTHWEST PASS
SHELL OIL PIPELINE
CHEVRON
TB-W-8

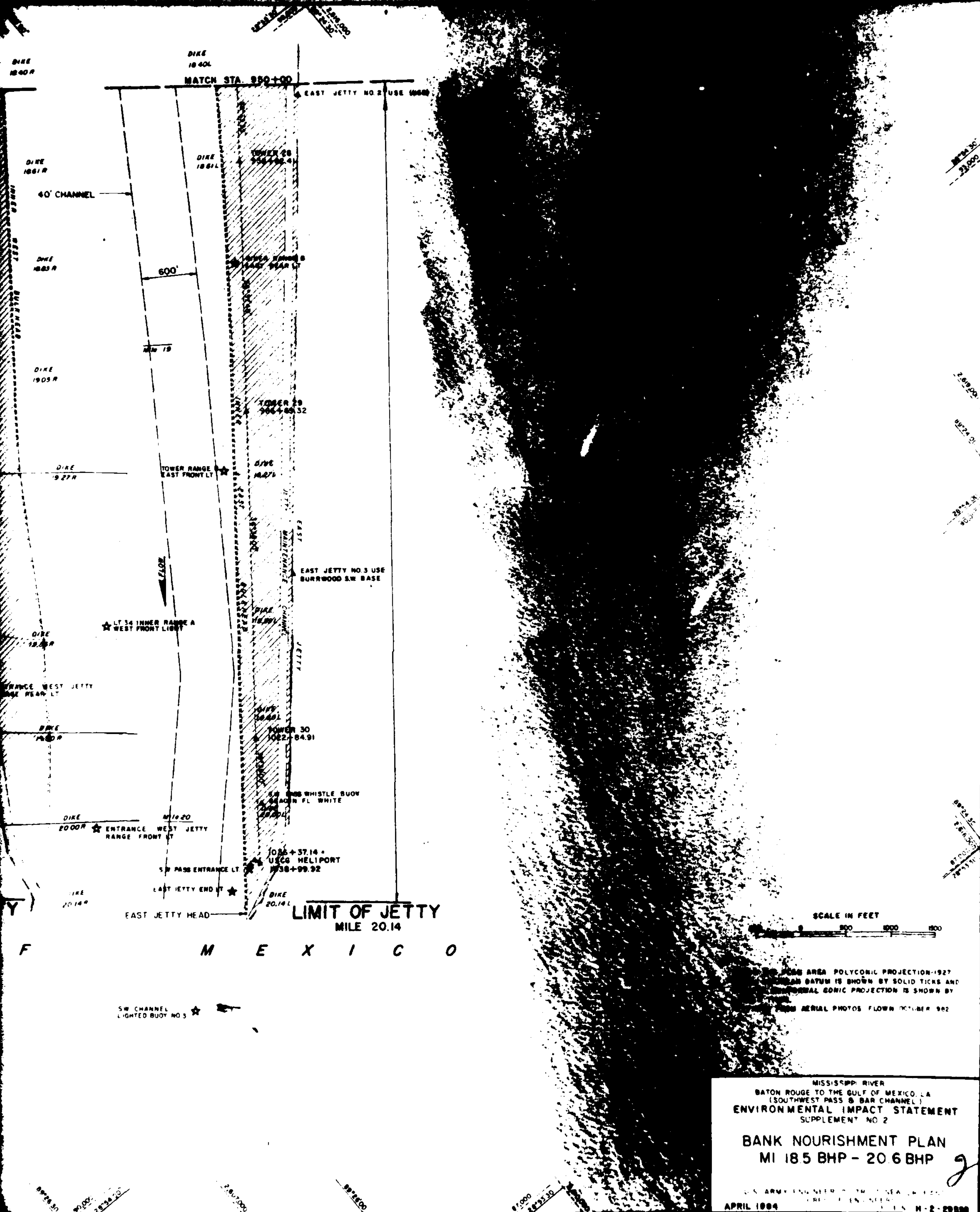

SOUTHWEST PASS
EAST BAY
S H, L A.
FLOW
WOOD LATITUDE
PIPE LINE
RADIO TOWER
▲EAST JETTY USE (NGS)
▲NORTHEAST FRONT RANGE BEACON (NGS)
CHEVRON TB
S.W. PASS LT. NO. 8
DIKE 16.79L
MATCH STA. 840+00
SCALE IN FEET
NOTES:
INSIDE THE PLAN AREA POLYCONIC PROJECTION-1927 NORTH AMERICAN DATUM IS SHOWN BY SOLID TICKS AND LAMBERT CONFORMAL CONIC PROJECTION IS SHOWN BY DASHED TICKS.
MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO, LA
(SOUTHWEST PASS & BAR CHANNEL)
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT NO 2
BANK NOURISHMENT PLAN
MI 14 2 BHP - 16 4 BHP
APRIL 1984
H 2 29598
PLATE 8


CHEVRON
TB W-8
CHEVRON BOAT
DOCK LIGHT
BAY
PLAQUEMINES
SOUTHWEST PASS
600'
CONCRETE CAP JETTY
40 CHANNEL
SOUTHWEST PASS FRONT RANGE LIGHT
S.W. PASS LT
NO 5
(Jetty Stab.) Mile
EAST JETTY BASE
BAR PILOT STATION
O F
600'

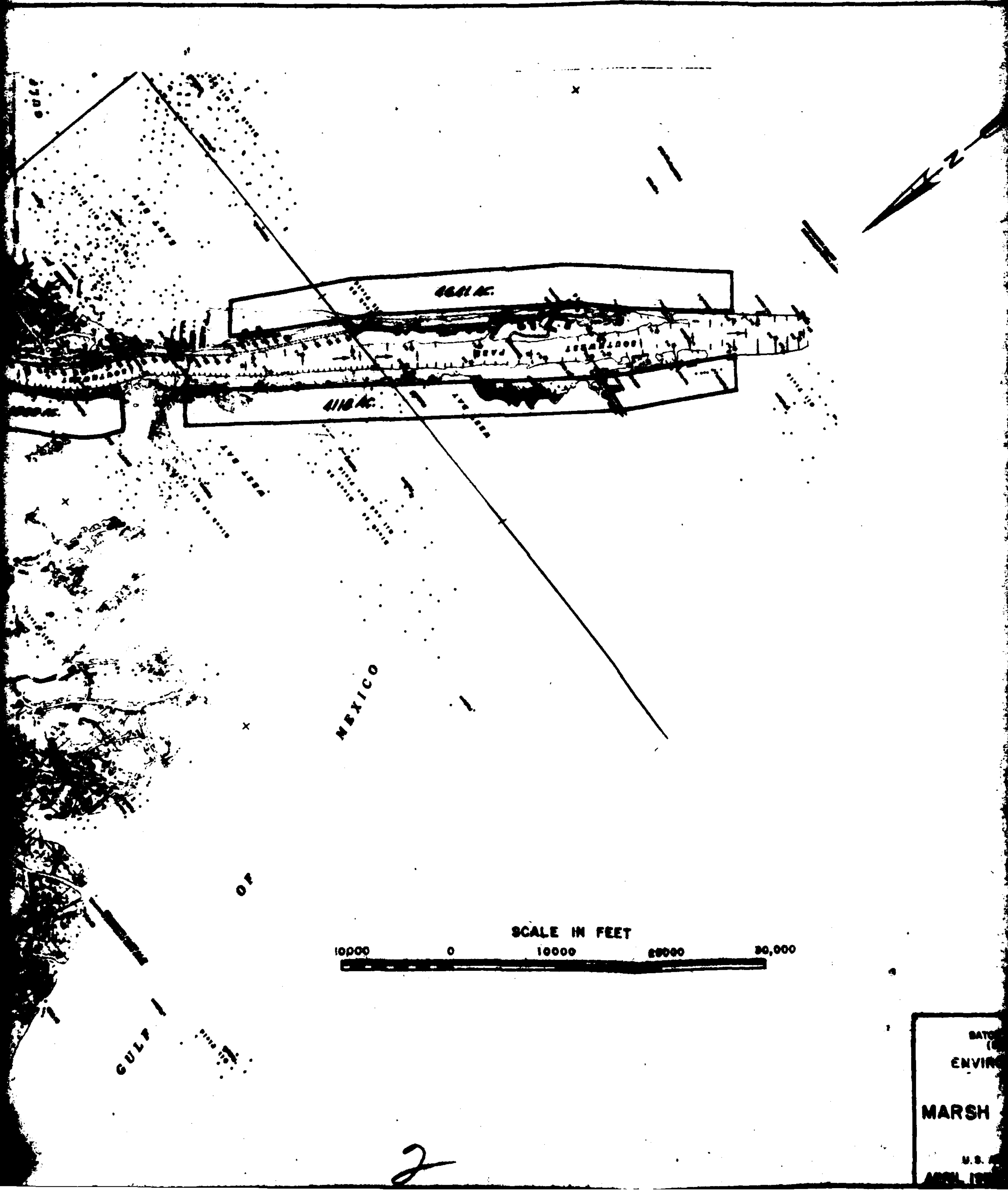

MATCH STA. 840+00
BURWOOD NORTHEAST BASE (NGS)
SOUTHWEST PASS
STONE JETTY
40' CHANNEL
EAST JETTY NO. 1 USE (NGS)
TOWER 26
PARISH, L
LIMIT OF JETTY
(Jetty Stab.) Mile 17.42
S.W. PASS LT. NO. 5
EAST JETTY GAGE
PILOT STATION
MAINTENANCE CHANNEL
EAST JETTY
MEXICO
600'
MATCH STA. 880+00
EAST JETTY NO 2 USE (NGS)
MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO, LA
(SOUTHWEST PASS & BAR CHANNEL)
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT NO 2
BANK NOURISHMENT PLAN
MI. 16.4 BHP - 18.5 BHP
U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
APRIL 1984
PLATE 19



DIKE
40' CHANNEL
600'
DIKE 20.00 R
ENTRANCE WEST JETTY RANGE FRONT LT
LIMIT OF JETTY
MILE 20.14
G U L F
O F
SW CHANNEL LIGHTED BUOY NO 3


MATCH STA. 950+00
EAST JETTY NO.2 USE
40' CHANNEL
600'
TOWER 29
TOWER RANGE
EAST FRONT LT
FLOW
EAST JETTY NO.3 USE
BURRWOOD S.W. BASE
LT 34 INNER RANGE A
WEST FRONT LIGHT
MAINTENANCE CHANNEL
EAST JETTY
ENTRANCE WEST JETTY
RANGE REAR LT
TOWER 30
1022+84.91
DIKE
20.00R
ENTRANCE WEST JETTY
RANGE FRONT LT
MILE 20
S.W. PASS ENTRANCE LT
1035+37.14
USCG HELIPORT
1038+99.92
EAST JETTY END LT
EAST JETTY HEAD
DIKE
20.14L
LIMIT OF JETTY
MILE 20.14
F M E X I C O
SW CHANNEL
LIGHTED BUOY NO 3
SCALE IN FEET
500 1000 1500
MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO, LA
(SOUTHWEST PASS & BAR CHANNEL)
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT NO 2
BANK NOURISHMENT PLAN
MI 18.5 BHP - 20.6 BHP
APRIL 1984
PLATE 20

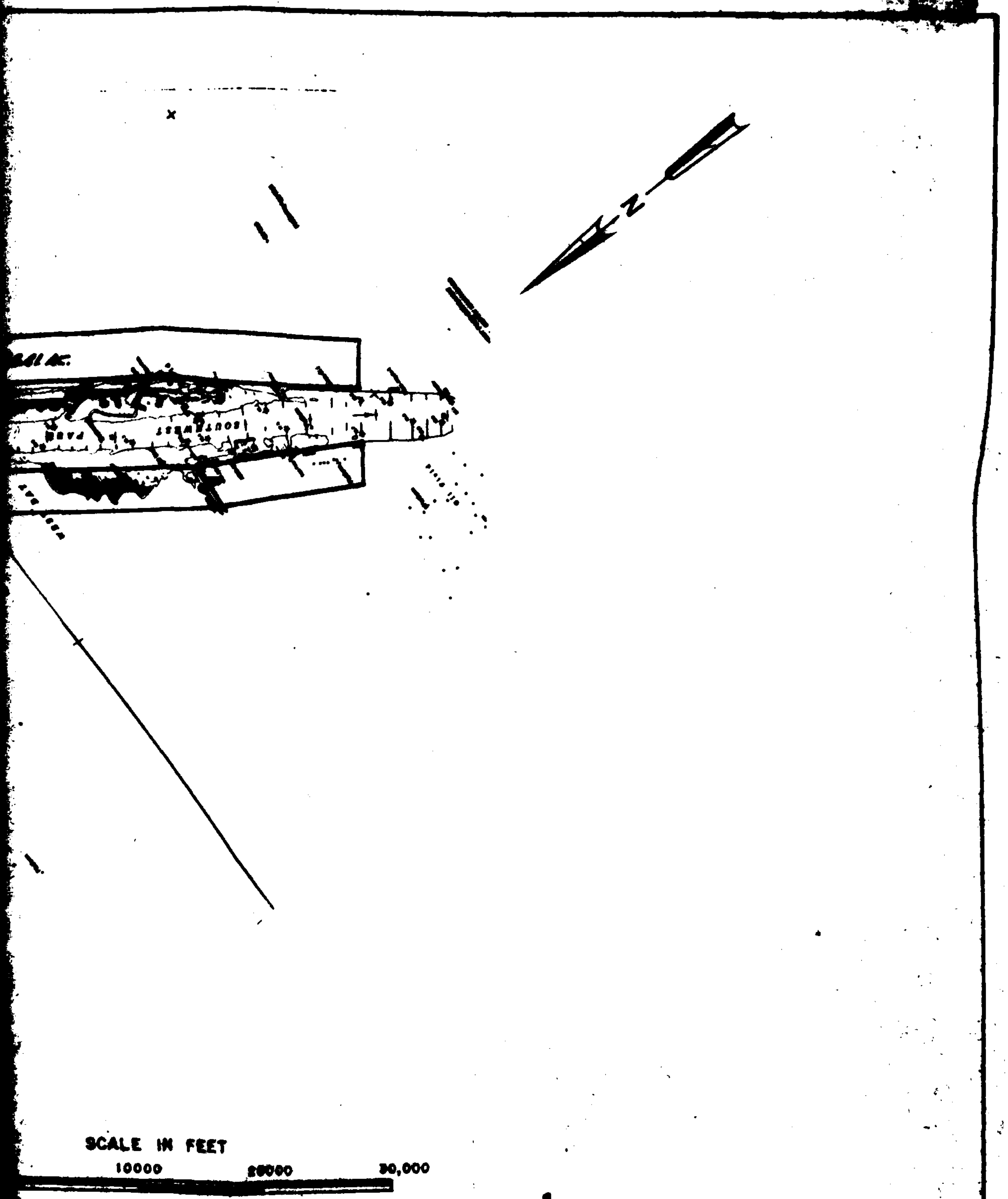
1000 AC.
RIVER
MISSISSIPPI
GULF



4641 AC.
4118 AC.
GULF OF MEXICO
SCALE IN FEET
10000 0 10000 20000 30,000
N


MARSH

2




MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO, LA.
(SOUTHWEST PASS & BAR CHANNEL)

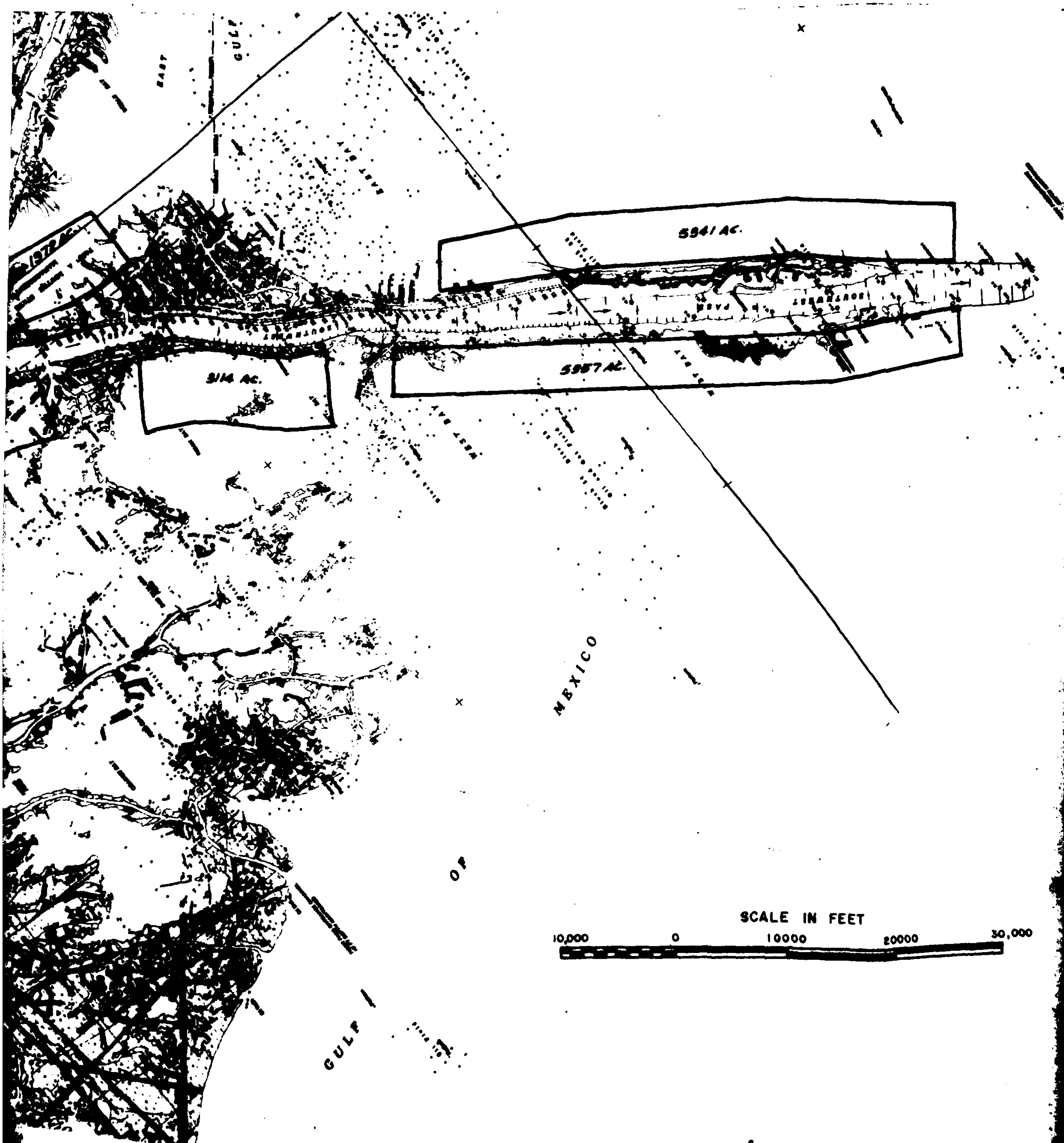
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT NO. 2

MARSH CREATION WITH PROJECT

3

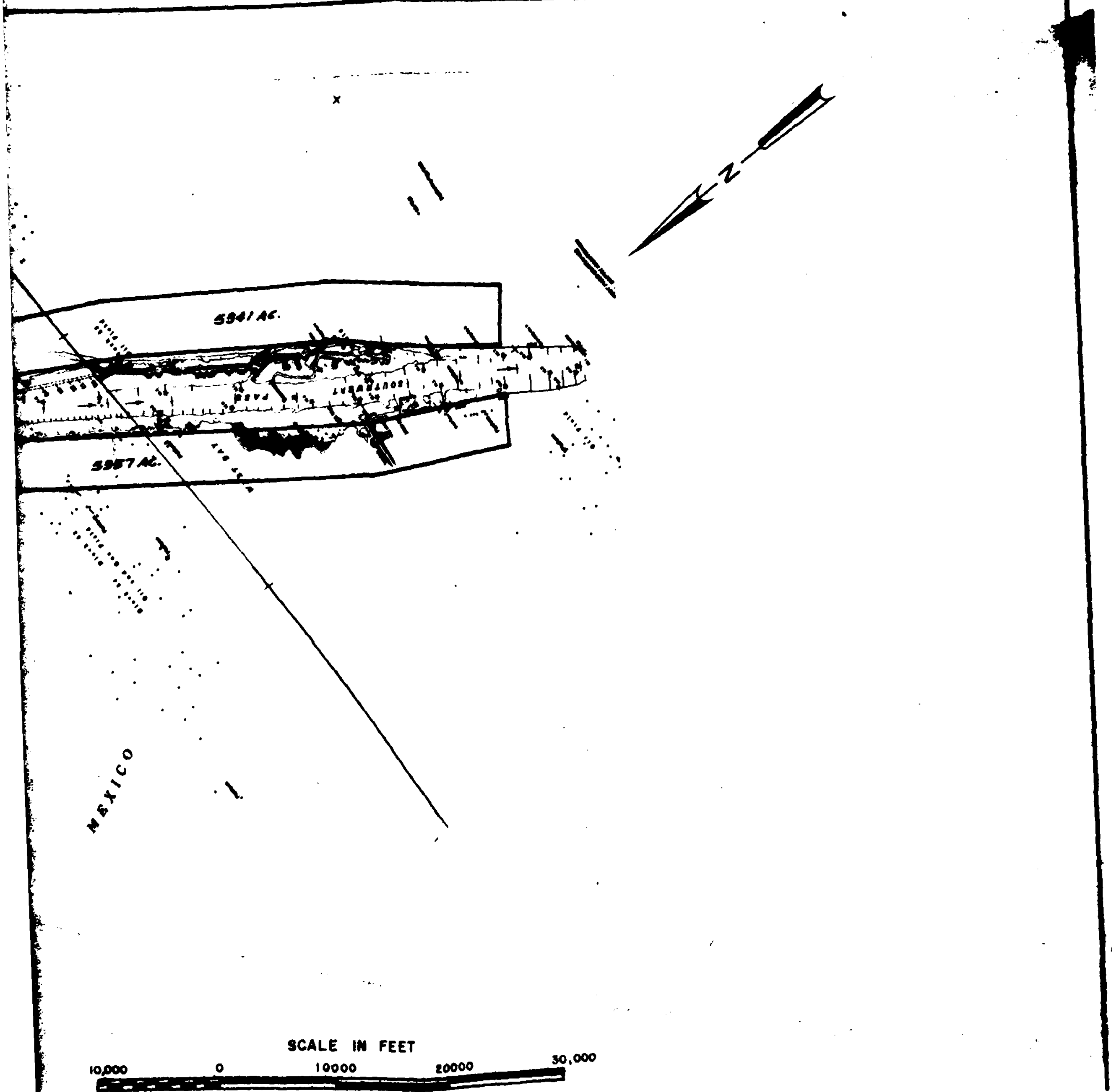
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

1972 AC.
1664 AC.
3116 AC.
RIVER
MISSISSIPPI



5941 AC.
5957 AC.
3114 AC.
1972 AC.
EAST BAY
WEST BAY
GULF OF MEXICO
SCALE IN FEET
10,000
0
10000
20000
30,000


2




MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO, LA
(SOUTHWEST PASS & BAR CHANNEL)
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT NO. 2

MARSH CREATION WITHOUT PROJECT

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

APRIL 1984

PLATE 22

1
2
8
3
5


N

## LEGEND

| NESTING COLONY[1] | SPECIES PRESENT[2] | NUM |
|---|---|---|
| 1. (603029) | GE, SE, LB, LH | 100 – |
| 2. (603031) | LT | [illegible] |
| 3. (603032) | LT | [illegible] |
| 4. (603033) | LT | [illegible] |
| 5. (603041) | GT, BS | 100 |
| 6. (603043) | FT | 500 |
| 7. (603061) | GE, SE, LH, LB, BC, PI, WI | 1,000 |
| 8. (603077) | GE, SE, LH, LB, BC, PI, WI | 1,000 |
| 9. (603078) | GT, BS | 2 -1 |

1. NUMBERS IN PARENTHESES ARE USED BY BIOLOGIST TO COLONIES DURING PERIODIC INVENTORIES
2. SPECIFIED ABBREVIATIONS: (PREDOMINANT SPECIE

| | |
|---|---|
| GE - GREAT EGRET | PI - WHITE-FAC |
| SE - SNOWY EGRET | WI - WHITE I |
| LH - LOUISIANA HERON | GT - GULL - BIL |
| LB - LITTLE BLUE HERON | FT - FORSTER'S |
| BC - BLACK - CROWNED NIGHT HERON | LT - LEAST T |
| | BS - BLACK S |

* INDICATES NO COLONY WAS OBSERVED DURING 198 HOWEVER A CRYPTIC SPECIES LIKE THE LEAST T OVERLOOKED.

SOURCES OF COLONY DATA:
KELLER, PERS. COMM. (AUGUST 1, 1983)
PORTNOY (1977)

9000 0 9000 18000

SCALE - FEET

MAP SOURCE U S FISH AND WILDLIFE SERVICE, 1978 "WETLAND CHANGES IN THE MISSISSIPPI RIVER ACTIVE DELTA (1956-1978)" NATIONAL COASTAL ECOSYSTEM TEAM, SLIDELL, LA AND BURK & ASSOCIATES, 1976 PLAQUEMINE PARISH, LA "HYDROLOGIC CHARACTERISTICS"

2

7


## LEGEND

| NESTING COLONY[1] | SPECIES PRESENT[2] | NUMBER OF ADULT BIRDS |
|---|---|---|
| 1. (603029) | GE, SE, LB, LH | 100 - 500 |
| 2. (603031) | LT | # |
| 3. (603032) | LT | # |
| 4. (603033) | LT | # |
| 5. (603041) | GT, BS | 100 - 500 |
| 6. (603043) | FT | 500 - 1,000 |
| 7. (603061) | GE, SE, LH, LB, BC, PI, WI | 1,000 - 5,000 |
| 8. (603077) | GE, SE, LH, LB, BC, PI, WI | 1,000 - 5,000 |
| 9. (603078) | GT, BS | 2 - 100 |

1. NUMBERS IN PARENTHESES ARE USED BY BIOLOGIST TO IDENTIFY THESE COLONIES DURING PERIODIC INVENTORIES
2. SPECIFIED ABBREVIATIONS: (PREDOMINANT SPECIES UNDERLINED)

| | |
|---|---|
| GE - GREAT EGRET | PI - WHITE-FACED AND/OR GLOSSY IBIS |
| SE - SNOWY EGRET | WI - WHITE IBIS |
| LH - LOUISIANA HERON | GT - GULL-BILLED TERN |
| LB - LITTLE BLUE HERON | FT - FORSTER'S TERN |
| BC - BLACK-CROWNED NIGHT HERON | LT - LEAST TERN |
| | BS - BLACK SKIMMER |

# INDICATES NO COLONY WAS OBSERVED DURING 1983 AERIAL INVENTORY HOWEVER A CRYPTIC SPECIES LIKE THE LEAST TERN COULD HAVE BEEN OVERLOOKED.

SOURCES OF COLONY DATA:
KELLER, PERS. COMM. (AUGUST 1, 1983)
PORTNOY (1977)

0 9000 18000

SCALE-FEET

...E U.S. FISH AND WILDLIFE SERVICE, 1978 "WETLAND ...N THE MISSISSIPPI RIVER ACTIVE DELTA (1956-1978)" COASTAL ECOSYSTEM TEAM, SLIDELL, LA AND BURK & ... 1978 PLAQUEMINE PARISH, LA "HYDROLOGIC ...ICS"

MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO LA
(SOUTHWEST PASS & BAR CHANNEL)
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT NO. 2

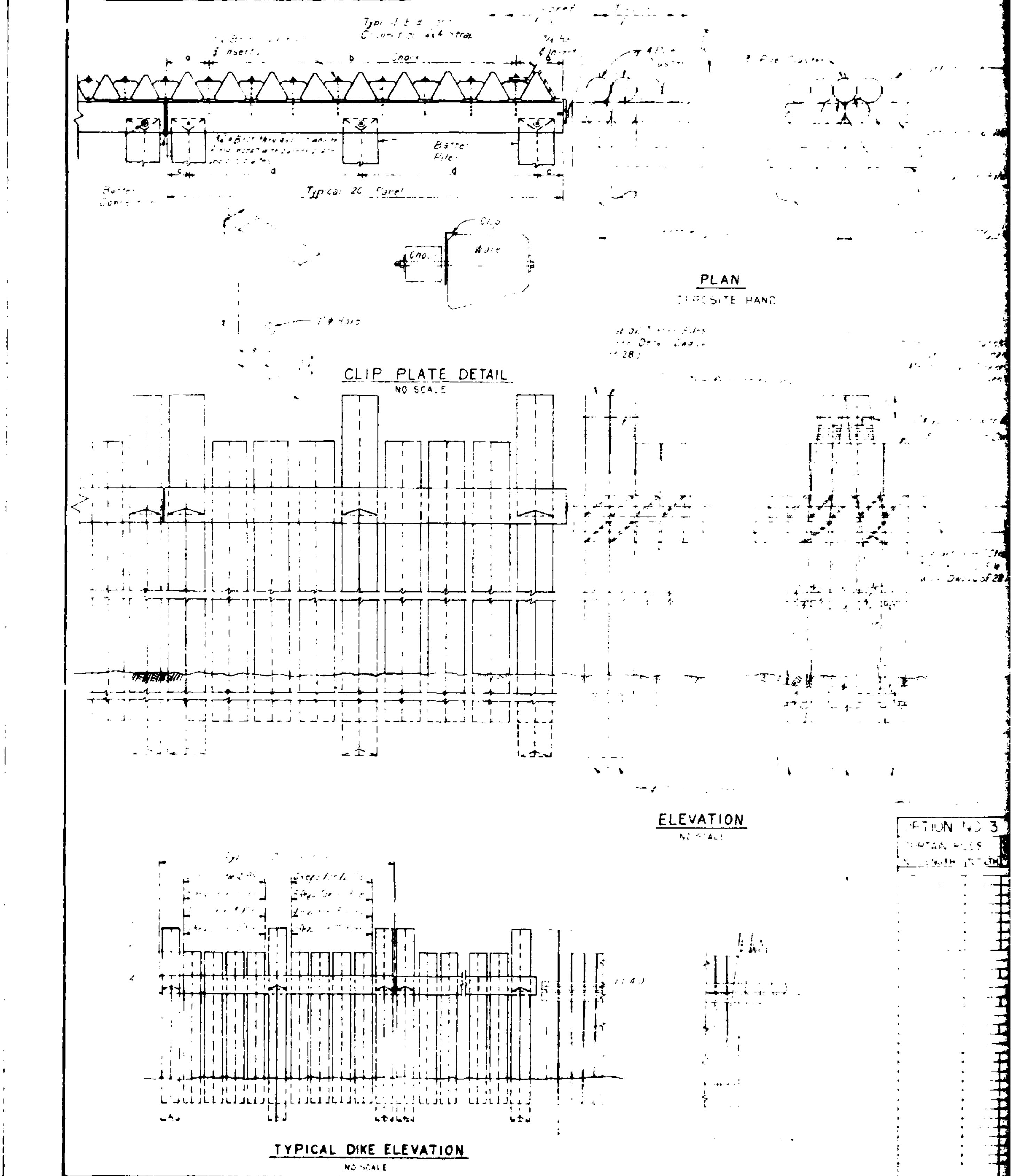
LOCATION OF SEABIRD AND WADING BIRD NESTING COLONIES IN THE PROJECT AREA

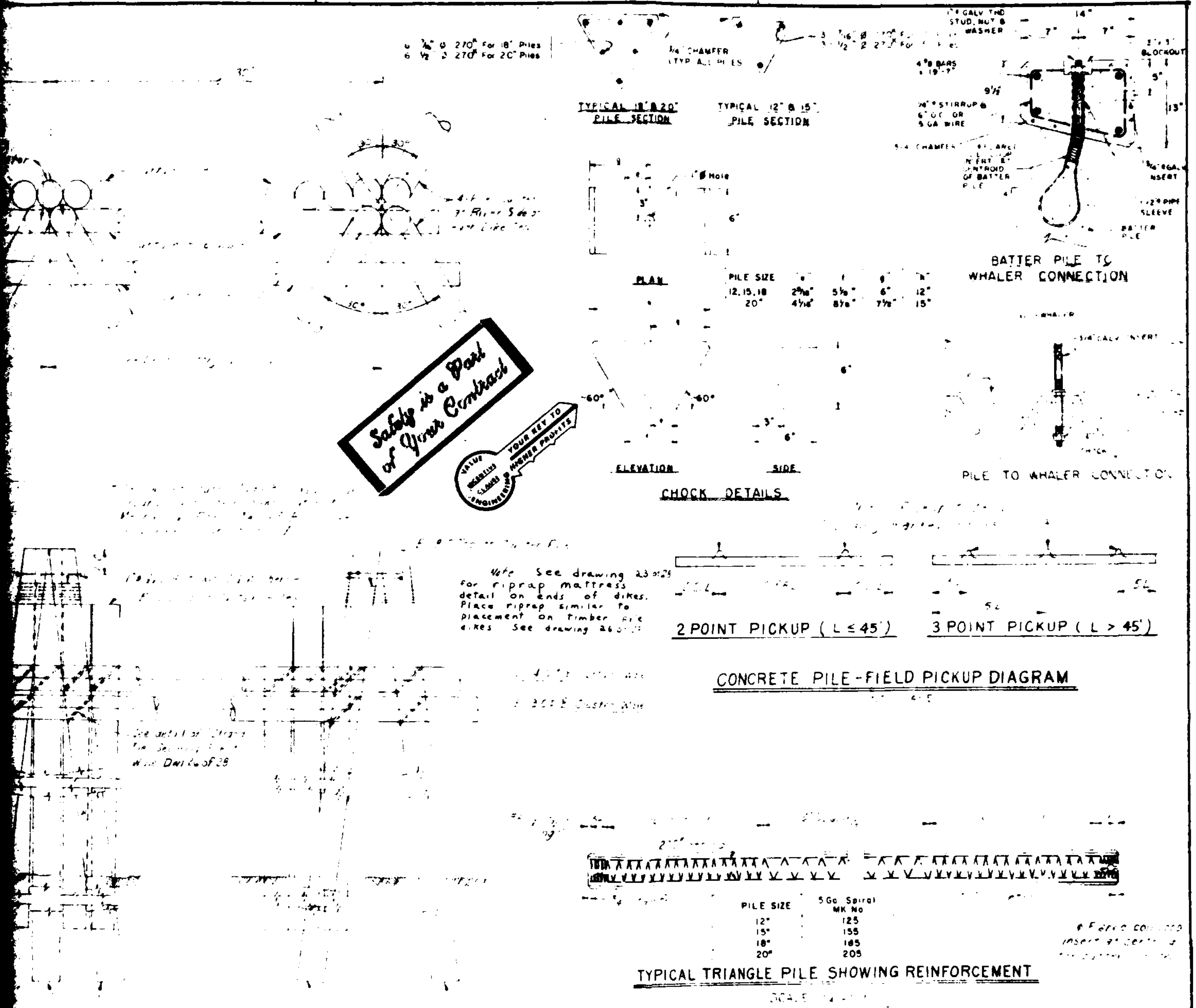
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

APRIL 1984 FILE NO. H-2-[illegible]

PLATE [illegible]

| PILE SIZE | "a" | "b" | "c" | "d" |
|---|---|---|---|---|
| 12" | 1'- | 13sp at 1'-4" | [illegible] | 9'-4" |
| 15" | 1'- /16" | sp at 1'-6 / | [illegible] | 9'-2 / |
| 18" | 1'- /8" | 9sp at 1'-9 / | [illegible] | 9'- /4" |
| 20" | 2 | 7sp at 2'-2 / | [illegible] | 8'-10 / |






| OPTION NO 3 | | | TRIANGLE CONC PILES & TIMBER PILES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CURTAIN PILES | | | CONC MARKER PILES OR TIMBER 3-PILE CLUST | | | CONC BATTER PILES OR TIMBER 4-PILE CLUST | | | WALES | | |
| NO | LENGTH | TOT LTH | NO | LENGTH | TOT LTH | NO | LENGTH | TOT LTH | NO | LENGTH | TOT LTH |

NOTES

1. SEE PROFILE FOR WOOD PILE LINE TO DETERMINE TOTAL LENGTH OF DIKE, LENGTH OF EACH PILE, AND SIZE OF EACH PILE
2. AFTER BOLTS HAVE BEEN TIGHTENED, EXPOSED BOLT THREADS SHALL BE COVERED WITH TAR TO PREVENT REMOVAL OF NUTS & WASHERS FROM EACH BOLT
3. CONCRETE WALES TO HAVE 3" OPENINGS BETWEEN ENDS SO AS TO FORM INDEPENDENT DIKE SECTIONS
4. CLEARANCES SHALL BE 1/2" FROM ALL CONCRETE SURFACES EXPOSED TO WEATHER

MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO, L.A.
(SOUTHWEST PASS & BAR CHANNEL)

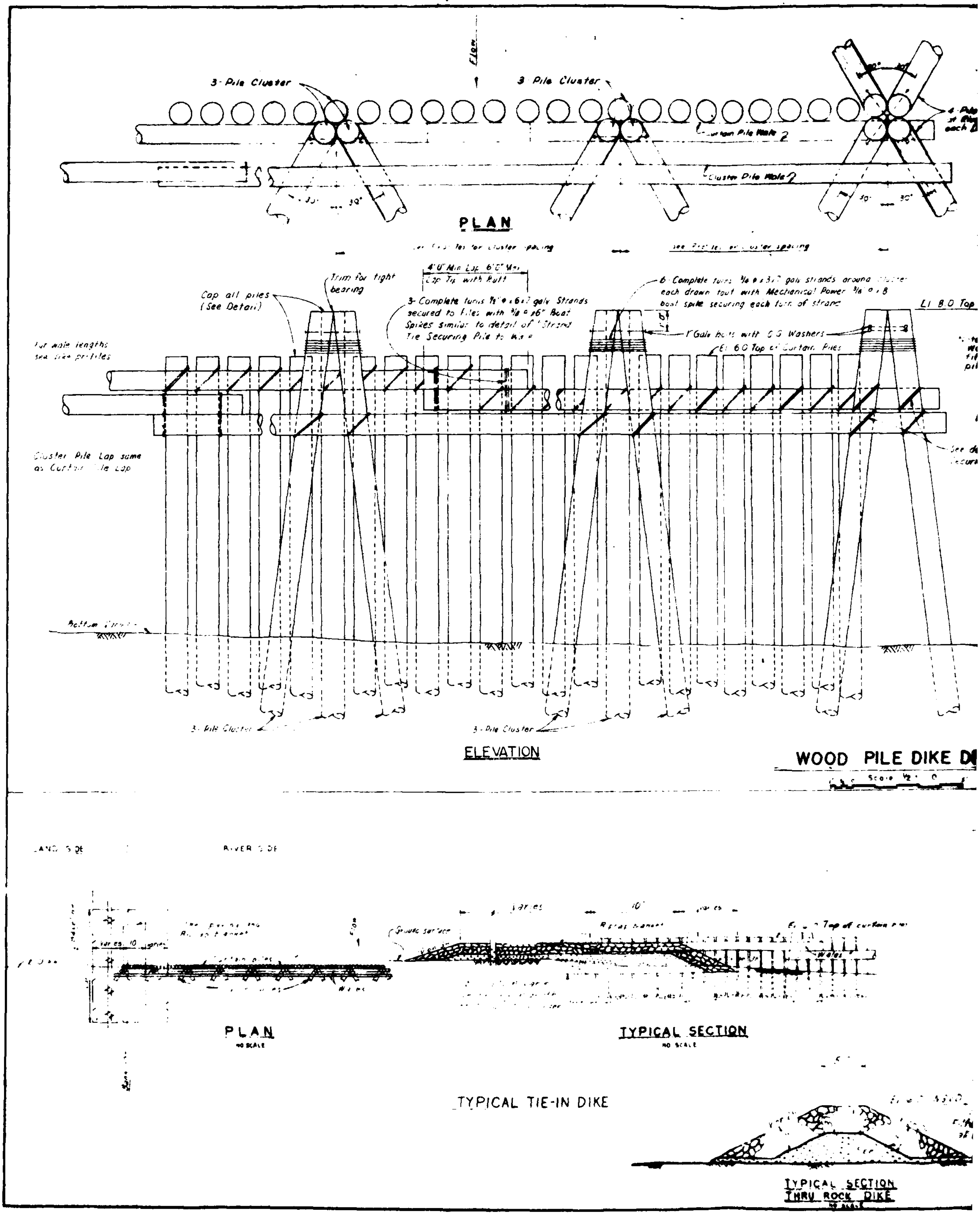
**ENVIRONMENTAL IMPACT STATEMENT**

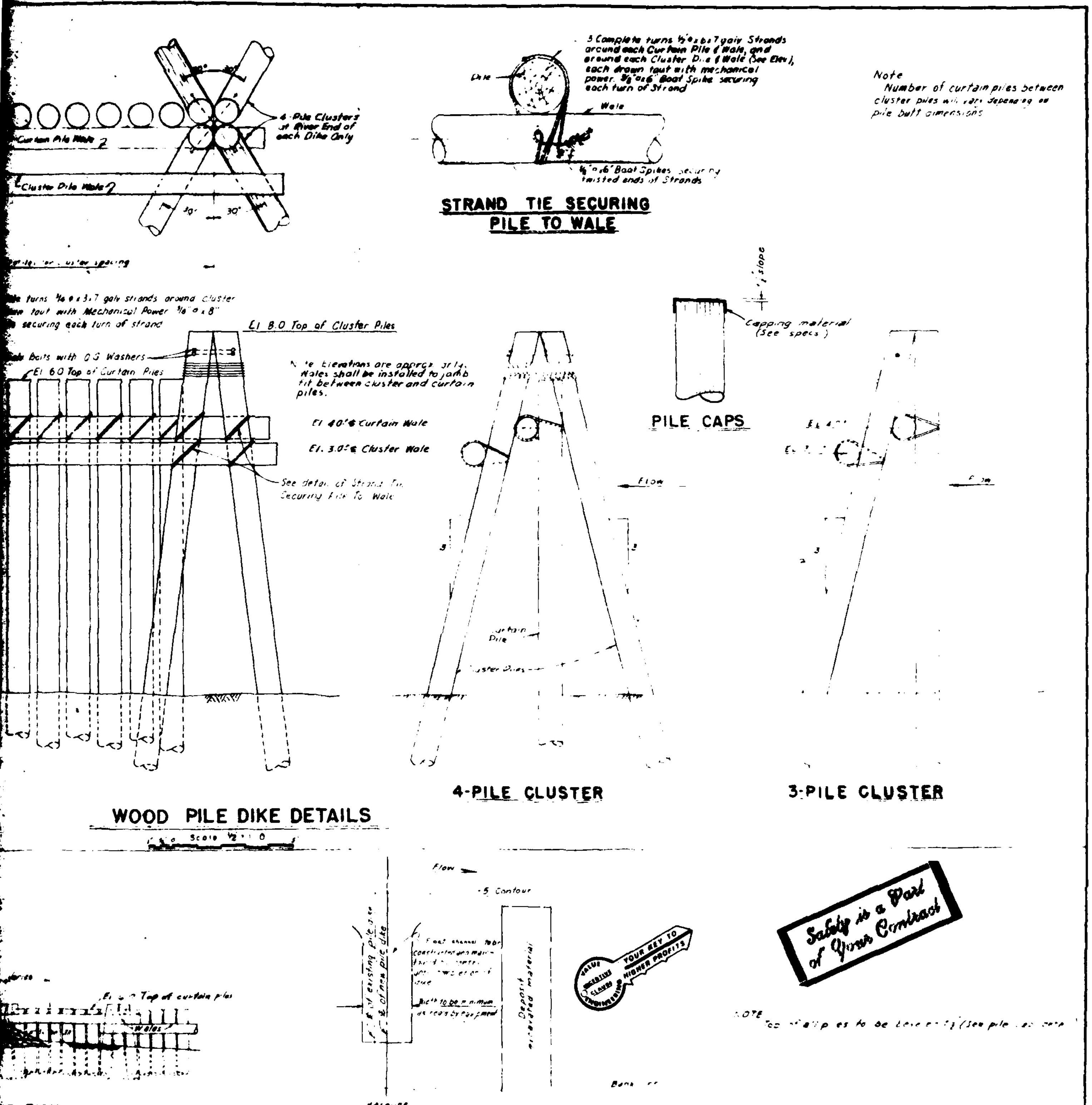
SUPPLEMENT NO. 2

# LATERAL PILE DIKES (CONCRETE)

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

APRIL 1984 FILE NO. H-2-29999


3-Pile Cluster
3 Pile Cluster
Flow
Curtain Pile Wale
Cluster Pile Wale
30°
PLAN
4'0" Min Lap 6'0" Max
Cap Tie with Butt
Trim for tight bearing
Cap all piles (See Detail)
3-Complete turns of galv Strands secured to Piles with Boat Spikes similar to detail of Strand Tie Securing Pile to Wale
6-Complete turns galv strands around cluster each drawn taut with Mechanical Power boat spike securing each turn of strand
1" Galv bolts with O.G. Washers
El 6.0 Top of Curtain Piles
El 8.0 Top
For wale lengths see dike profiles
Cluster Pile Lap same as Curtain Pile Lap
Bottom
3-Pile Cluster
3-Pile Cluster
ELEVATION
WOOD PILE DIKE D
LAND SIDE
RIVER SIDE
Varies
10'
Flow
Ground surface
Riprap blanket
Top of curtain piles
Curtain piles
Wales
PLAN
NO SCALE
TYPICAL SECTION
NO SCALE
TYPICAL TIE-IN DIKE
TYPICAL SECTION
THRU ROCK DIKE
NO SCALE




MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO, LA.
(SOUTHWEST PASS & BAR CHANNEL)

**ENVIRONMENTAL IMPACT STATEMENT**

SUPPLEMENT NO. 2

## LATERAL PILE DIKES (TIMBER)

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

APRIL 1984 FILE NO. H-2-29896

**PLATE 25**

## 9.3. LIST OF APPENDIXES

The following appendixes are bound with this EIS:

A. Common and Scientific Names of Plants
B. Biological Assessment of Endangered/Threatened Species
C. Cultural Resources
D. Recreational Resources
E. Water Quality
F. Section 404 (b)(1) Evaluation
G. Consistency Determination - Louisiana Coastal Resources Program
H. Draft Fish and Wildlife Coordination Act Report

MISSISSIPPI RIVER, BATON ROUGE TO THE GULF,
LOUISIANA, PROJECT

DRAFT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT II

APPENDIX A
COMMON AND SCIENTIFIC NAMES OF PLANTS

APRIL, 1984

The following is an alphabetized list of the common names of plants discussed in the EIS, with corresponding scientific names. This list is taken from Montz (1975a, 1975b) who used the following taxonomic sources: Correll and Johnston (1970); Fernald (1950); Gleason (1968); Hitchcock (1950); Lasseigne (1973); Radford, et al. (1968); and Small (1933).

List of Common and Scientific Names of Plants Mentioned in the EIS

| | |
|---|---|
| Alligatorweed | Alternanthera philoxeroides |
| Baldcypress | Taxodium distichum |
| Bermuda grass | Cynodon dactylon |
| Bigelow glasswort | Salicornia bigelovii |
| Black rush | Juncus roemerianus |
| Black willow | Salix nigra |
| Bulltongue | Sagittaria falcata |
| Bullwhip | Scirpus californicus |
| Cattail | Typha spp. |
| Coffeeweed | Sesbania exaltata |
| Dogtooth grass | Panicum repens |
| Drummond red maple | Acer drummondii |
| Eastern baccharis | Baccharis halimifolia |
| Green ash | Fraxinus pennsylvanica |
| Leafy threesquare | Scirpus robustus |
| Maidencane | Panicum hemitomon |
| Marsh elder | Iva frutescens |
| Nightshade | Solanum spp. |
| Oystergrass | Spartina alterniflora |
| Pennywort | Hydrocotyl spp. |
| Persimmon | Diospyros virginiana |
| Pickerelweed | Pontederia cordata |
| Rattlebox | Daubentonia drummundii |
| Roseau | Phragmites australis |
| Saltgrass | Distichlis spicata |
| Saltwort | Batis maritima |

| | |
|---|---|
| Sandbar willow | *Salix interior* |
| Seaside heliotrope | *Heliotropium curassavicum* |
| Three-cornered grass | *Scirpus olneyi* |
| Thoroughwort | *Eupatorium spp.* |
| Walter's millet | *Echinocloa walteri* |
| Wiregrass | *Spartina patens* |

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MISSISSIPPI RIVER, BATON ROUGE TO THE GULF,
LOUISIANA, PROJECT

DRAFT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT II

APPENDIX B
BIOLOGICAL ASSESSMENT OF ENDANGERED/THREATENED SPECIES

APRIL, 1984

APPENDIX B

BIOLOGICAL ASSESSMENT OF ENDANGERED/THREATENED SPECIES

## INTRODUCTION

This assessment addresses the endangered and threatened species which might be affected by the "Mississippi River, Baton Rouge to the Gulf, Louisiana," project. To fulfill requirements pursuant to Section 7 of the Endangered Species Act Amendments of 1978, the New Orleans District, U. S. Army Corps of Engineers, informed the National Marine Fisheries Service (NMFS), and the U.S. Fish and Wildlife Service (FWS) of the proposed project and requested an endangered and threatened species list applicable to the project area. The species these agencies suggested could potentially be affected are listed in Table B-1. No threatened or endangered plants are known to occur in the project area.

TABLE B-1

ENDANGERED AND THREATENED SPECIES LIKELY TO OCCUR IN THE VICINITY OF THE MISSISSIPPI RIVER, BATON ROUGE TO THE GULF, LOUISIANA, PROJECT.

| | |
|---|---|
| ENDANGERED SPECIES | |
| Kemp's Ridley Sea Turtle | *Lepidochelys kempii* |
| THREATENED SPECIES | |
| Green Sea Turtle | *Chelonia mydas* |
| Loggerhead Sea Turtle | *Caretta caretta* |

The River and Harbor Act of 1945 (Public Law 79-14) authorized the "Mississippi River, Baton Rouge to the Gulf of Mexico, Louisiana," project. The purpose of the recommended project is the reduction of sediment accumulation in the Mississippi River below Venice, Louisiana, and Southwest Pass. Because of the rapid subsidence of the natural banks in this area, and the associated loss of water over them, increased shoaling has occurred. This project would reduce dredging needs, especially the use of hopper dredges in the jetty reach of Southwest Pass.

The recommended project consists of foreshore dikes, bank nourishment, freshwater outlets, jetty stabilization, and inner bulkheads along the Mississippi River below Venice and Southwest Pass. Lateral pile dikes might be constructed in the future. Marsh creation would be associated with maintenance of the 40-foot navigational channel. Foreshore dikes are shell-core, rock-capped dikes which parallel the river or pass and which would be constructed to a design height of +7.5 feet National Geodetic Vertical Datum (NGVD) in the reach between Venice and Head of Passes and +7.0 feet NGVD in Southwest Pass. The dike center line would be aligned with the -2.5-foot NGVD contour for the upper reach and -1.8-foot NGVD (weighted average) for the lower. A -8.0-foot NGVD flotation channel would be bucket dredged adjacent to the dikes, and about 2 million cubic yards of material removed and placed in the river and pass adjacent to the channel. After the construction of the foreshore dikes, the area bayward of the dikes would be nourished with fill hydraulically dredged from the river and pass. The design elevation of the dikes is 4.5 feet NGVD between Venice and the Head of Passes and +4.0 feet NGVD in Southwest Pass. The east and west jetties in Southwest Pass would be stabilized and inner bulkheads constructed parallel to them. Fill deposited to a design elevation of +4.0 feet NGVD would be placed between the jetties and bulkheads. Approximately 2,100 acres of shallow river and pass waters would be filled and an additional 1,000 acres of

river and pass waters and water bottoms temporarily impacted. In the future, lateral pile dikes might be constructed. These dikes are made of concrete or timber pilings and constructed perpendicular to the river bank. They serve to reduce the cross-sectional area of the river and pass, thus, increasing flow velocities and reducing shoaling. If the lateral pile dikes are constructed, an additional 900 acres of Mississippi River waters and water bottoms would be eliminated. Because the foreshore dikes and bank nourishment would prevent freshwater inflow into adjacent wetlands, four, 100-feet wide, low-weir rock outlets would be constructed on the west side of the river. These four outlets would allow about 50% of the present low flow to go over bank. Two existing outlets on the east bank above Head of Passes would remain open. Much of the project dredged material would be disposed in open water. Marsh would develop as a by-product of this unconfined disposal. The total acreage of marsh created would be reduced over what would occur without the project features because the project would reduce dredging and disposal. A maximum of 13,600 acres of marsh would be created with the project and 28,400 acres without the project.

This assessment is the result of several visits to the project area, conversations with knowledgeable persons, and a review of current literature. The following includes a discussion of each species, a summary of historic and current occurrences in Louisiana, and the effects the project could have on each species. The cumulative effects are examined and conclusions presented. No difficulties were encountered in obtaining data and completing the project; however, information on sea turtle distribution and abundance in Louisiana was lacking.

## SPECIES ASSESSMENT

### KEMP'S RIDLEY SEA TURTLE

The Kemp's ridley is regarded as the smallest of the sea turtles and averages 20 to 60 pounds, although individuals of nearly 100 pounds have been recorded. The carapace is relatively round in dorsal profile, and the predominate coloration of dorsal surfaces of the head, limbs, and carapace is light gray. Individuals with an olive green to brownish carapace also occur (Pritchard and Marquez, 1973).

The distribution of the Kemp's ridley is basically restricted to the waters of the Gulf of Mexico, although several reports of this species exist for the Caribbean Coast of Colombia (Chavez and Haufmann, 1974). From April to August, small aggregations of ridleys lay eggs on a 14-mile stretch of beach (Rancho Nuevo) in Tamaulipas, Mexico. The Kemp's ridley is a daytime (diurnal) nester, which among the sea turtles is unique. In 1947, it was estimated that the number of nesting female ridley sea turtles was roughly 40,000; however, the number has declined to about 500 as of 1978. The taking of ridley sea turtle eggs and skins has played a major part in the decline (Pritchard and Marquez, 1973). Natural predation of hatchlings is also high. The Mexican Government, in an effort to protect the remaining Kemp's ridleys, has prohibited harvesting and guards the colonies' only known nesting beach. However, no upward population trend has been noted. In 1977, a small turtle was sighted on the sandy beach of Timbalier Island, Louisiana. It was

presumed to be a female ridley looking for a nesting site (National Fish and Wildlife Laboratory, 1981).

Numerous sightings of ridleys feeding in the rich shallow estuarine and inshore areas suggest that these areas are important feeding grounds for these turtles. Many of the food items recorded for the ridley, such as crabs, shrimp, snails, sea urchins, fishes, and marine plants, inhabit estuarine and inshore areas with silt substrates. Subsequently, adult and subadult ridleys might feed in the highly productive white shrimp-portunid crab beds of Louisiana. As a result, ridleys could be caught in nets during shrimp fishing season and drowned. Adults tagged while nesting at Rancho Nuevo have subsequently been recovered in the shrimp-rich coastal areas of the Louisiana coast and Campeche, Mexico. This recovery data indicates that coastal Louisiana and Campeche, have the highest non-nesting ridley populations. Between 1952 and 1958, 14 ridleys were captured in Louisiana waters. Of 1,038 turtles tagged between 1966 and 1969, 51 were recaptured outside the tagging location. About 30 percent of those recaptured were off the Louisiana coast (Zwineburg, 1977). Pritchard and Marquez (1973) found that about two-thirds of those turtles tagged in 1970 were recaptured off the Louisiana coast. In May 1981, a dead Kemp's ridley sea turtle was found on Grand Terre Island (McGehee, 1981). In 1982, no ridleys were observed off the Louisiana coast (Mager, NMFS, personal communication, 1982). The turtle might overwinter in a dormant state while buried in the silts in the shallow water estuarine systems of the Gulf of Mexico. Although winter torpor has not been adequately documented for the ridley, Florida turtles are often reported covered with mud during the spring (Pritchard and Marquez, 1973).

GREEN SEA TURTLE

Despite its common name, the green sea turtle (Chelonia mydas) can be extremely variable in coloration (Frazier, 1971). Green turtles from the Atlantic coast of the United States and Mexico are usually described as having an olive green to brown carapace, a white to light yellow plastron; and the limbs, head, and neck are colored much like the comparable areas of the carapace and plastron (Carr, 1952; 1961). The carapace of the green turtle in a dorsal view is heart-shaped or oblong. Green sea turtles are primarily herbivorous and feed on marine grasses and algae; although molluscs, sponges, crustaceans, and jellyfish are occasionally consumed. Green turtles are often observed in the open sea moving to and from major feeding grounds. Carr (1961) and Hirth (1971) include portions of the west coast of Florida and the northern coast of Yucatan as major feeding areas for green turtles. Hildebrand (1979) has found green turtles feeding in coastal lagoons of south Texas.

Green turtles nest on sand beaches throughout their range between 30° north and 30° south latitude (Ingle and Smith, 1949). Tortuguero, Costa Rica, and Aves Island are considered to be major rookeries for the Caribbean region. The rookeries closest to the Gulf of Mexico and South Atlantic coast of the United States are the east coast of Florida (Lund, 1974) and Quintana Roo, Mexico (Marquez, 1976). These rookeries annually are frequented by up to 50 to 100 nesting females. These nocturnal turtles lay from three to seven clutches during a nesting season. The female might only nest every 2 to 4 years (National Fish and Wildlife Laboratory, 1981).

The green sea turtle is distributed throughout the tropical waters and is known to occur as a straggler in many peripheral areas. It occurs in the Atlantic Ocean, Caribbean Sea, Gulf of Mexico, and Mediterranean Sea. A small but significant fishery of green turtles existed in Louisiana and Texas during the late 1800's and first half of this century. Currently, they are rarely seen in Louisiana, and none have been reported in recent years (Mager, 1982; Ogren 1982).

LOGGERHEAD SEA TURTLE

The loggerhead sea turtle (Caretta caretta) is a turtle averaging 20 to 50 inches in length. The carapace is heart-shaped, depressed, and reddish-brown in color but might be tinged with olive, with scutes often bordered with yellow. Ernst and Barbour (1972) reported that loggerheads might well be the largest living hard-shelled turtle. Adults average about 300 pounds, but considerably larger individuals have been recorded. Pritchard (1967) reported documented weights up to 1,000 pounds.

The loggerhead is omnivorous, feeding on some marine grasses and seaweeds, crabs, barnacles, conchs, mussels, clams, oysters, sponges, jellyfish, squid, amphipods, sea urchins, tunicates, and various fishes (Carr, 1952; Ernst and Barbour, 1972; Rebel, 1974). They often enter bays, lagoons, and estuaries (Ernst and Barbour, 1972) and frequently forage around coral reefs, rocky places, and old boat wrecks.

The nesting season of the loggerhead turtle in the southeastern United States occurs from April through August, with a peak in June (Ernst and Barbour, 1972; Rebel, 1974). Most nests are dug at night above the high-tide mark during periods of high tides on open beaches or along narrow bays, usually seaward from the dune front. Loggerheads usually nest every second or third year with two or three nestings a season (Caldwell, 1962). The principal nesting range is the Atlantic coast from about Cape Lookout, North Carolina, to Florida (Caldwell et al., 1959). Outside of the major nesting areas in Florida, most of the limited nesting recorded in the Gulf has been from Louisiana (East of the Mississippi River) to the panhandle of Florida. Within this area, most of the nesting has occurred on the Chandeleur Islands in Louisiana, and Horn, Ship, and Petit Bois Islands in Mississippi and Alabama (Ogren, 1977). Erosion of the Chandeleurs might be a factor in the decrease in nesting over the years. Overall, the disappearance of this

turtle from some parts of its original range and the decrease in nesting numbers in certain areas indicate the population is declining. Approximately 25,000 to 50,000 sexually mature loggerheads remain in the southeastern United States (Anon. 1978).

The loggerhead sea turtle occurs in tropical and temperate waters of all oceans including, but not limited to: the Atlantic, Indian, and Pacific Oceans, and the Caribbean Sea, Mediterranean Sea, and Gulf of Mexico. Caldwell et al. (1955b) and Ernst and Barbour (1972) consider the loggerhead to be a confirmed wanderer, ranging throughout the warm and temperate seas of the world. Information pertaining to loggerhead movement comes mainly through tagging studies. A female initially tagged at Fort Pierce, Florida, was recovered 130 miles to the north off Daytona Beach, Florida (Caldwell et al., 1955). A female tagged at Tongaland, Natal, Africa, was recovered more than 1 year later 1,500 miles to the north near Mikindani, Tanzania, Africa (Hughes and Mentis, 1967). Loggerheads may bury themselves in the silts of navigational channels and remain in a torpid condition during periods of cold weather (Carr et al., 1980). If any sea turtle was to frequent the project area, it would be the loggerhead (Ogren, 1982). According to the National Marine Fisheries Service, although a few loggerheads have been observed off the Louisiana coast in past aerial surveys, no recent sightings have been recorded (Mager, personal communication, 1982).

## IMPACTS

The potential for direct project impacts on sea turtles is slight. These turtles rarely occur in the Mississippi River and are mobile enough to avoid injury during project construction.

Indirect impacts would result primarily from unconfined disposal of dredged material. Sea turtles are likely to be found in the shallow estuarine water bodies and grassbeds of the project area. The creation of up to 13,600 acres of marsh in these estuarine areas would temporarily decrease turtle habitat and food resources; however, the productivity of these marshes would enhance these food resources within a few years. As a result of dredged material disposal, there would be a substantial release of suspended solids and a concomitant increase in turbidity, potential elevation of water temperatures, and a possible release of toxic materials into the water. The disposal of dredged material would smother benthic organisms that occur within the disposal areas. This disposal also would create the potential for bioaccumulation of contaminants by benthic organisms that repopulate the disposal areas. Vegetative growth and contaminant bioaccumulation studies suggest that there would be no short-term acute toxic effects on marsh productivity because of contaminants present in dredged sediments. Results indicate a potential for PCB, mercury, and some phthalate esters to bioaccumulate in plants after intertidal disposal. Mortality rates of benthic organisms in bioassay studies and contaminant concentrations in sediment elutriates indicate marsh creation with dredged sediments would have no short-term acute toxic effects on benthic organisms inhabiting this area. However, the results of contaminant bioassay studies indicate there might be some potential for cadmium and mercury bioaccumulation. A comparison of existing dredged sediment marsh interstitial water levels with the U. S. Environmental Protection Agency determined levels for chronic impacts indicated cadmium could adversely affect aquatic populations after marsh creation. The impact of this potential long-term bioaccumulation on the turtles is difficult to assess. Because turtles are mobile and wide-ranging, they would not be expected to feed in the project vicinity for extended periods. This should, therefore, substantially reduce the potential for adverse impacts on the turtles from long-term bioaccumulation.

## CONCLUSION

Direct construction impacts, and indirect operational effects, associated with the "Mississippi River, Baton Rouge to the Gulf, Louisiana," project are not expected to adversely effect any endangered or threatened species examined in this assessment.

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RELEVANT CORRESPONDENCE

# United States Department of the Interior

**FISH AND WILDLIFE SERVICE**

JACKSON MALL OFFICE CENTER
300 WOODROW WILSON AVENUE, SUITE 3185
JACKSON, MISSISSIPPI 39213

January 17, 1983

IN REPLY REFER TO:
Log No. 4-3-83-081

Mr. Cletis R. Wagahoff
ATTENTION: LMNPD-RE
U.S. Army, Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160

Dear Mr. Wagahoff:

This responds to your letter of January 10, 1983, requesting endangered species information for the vicinity of the Mississippi River, Baton Rouge to the Gulf, GDM, Supplement No. 2 Project, Plaquemenes Parish, Louisiana.

Our records indicate no endangered, threatened or proposed species, or their Critical Habitat occurring in the project area. Therefore, no further endangered species consultation will be required for this project, as currently described.

You should be aware that the only osprey (Pandion haliaeetus) nest in Louisiana occurs in the project vicinity. This species is not protected by the Endangered Species Act but is a species of concern within the State of Louisiana.

For further endangered species coordination on this project, please contact Judy Jacobs of our staff, telephone 601/960-4900, FTS 490-4900.

We appreciate your participation in the effort to protect endangered species.

Sincerely yours,

Dennis B. Jordan
Field Supervisor
Endangered Species Field Office

cc: D, FWS, Washington, D.C. (AFA/OES)
RD, FWS, Atlanta, GA (AFA/SE)
Department of Wildlife & Fisheries, New Orleans, LA
ES, FWS, Lafayette, LA

**UNITED STATES DEPARTMENT OF COMMERCE**
**National Oceanic and Atmospheric Administration**
NATIONAL MARINE FISHERIES SERVICE
Southeast Region
9450 Koger Boulevard
St. Petersburg, FL 33702

January 10, 1983

Mr. Cletis R. Wagahoff
Chief Planning Division
New Orleans District, Corps of Engineers
P.O. Box 602267
New Orleans, Louisiana 70160

Dear Mr. Wagahoff:

This responds to your January 5, 1983, letter regarding the Mississippi River, Baton Rouge to the Gulf, GDM, Supplement No. 2, Louisiana project. You requested a list of endangered/threatened species under our purview that may be found in the project area. The request was made pursuant to Section 7 of the Endangered Species Act of 1973.

The attached list provides the threatened and endangered species under National Marine Fisheries Service jurisdiction that may be present in the project area. Upon receipt of the list the Corps of Engineers must ensure that its actions are not likely to jeopardize the continued existence of the listed species.

For a major Federal action, the agency must conduct a biological assessment to identify any endangered or threatened species which are likely to be affected by such action. The biological assessment must be complete within 180 days after receipt of the species list, unless it is mutually agreed to extend this period. The components of a biological assessment are also attached.

At the conclusion of the biological assessment, the Federal agency should prepare a report documenting the results.

If the biological assessment reveals that the proposed project is likely to adversely affect listed species, the formal consultation process shall be initiated by writing to the Regional Director at the address on the letterhead. If no adverse affect is evident, there is no need for formal consultation. We would however, appreciate the opportunity to review your biological assessment.

The Fish and Wildlife Service should also be contacted for endangered/threatened species under their purview.

If you have any questions, please contact Andreas Mager, Jr., Fishery Biologist, FTS 826-3366.

Sincerely yours,

Chuck Oravetz

Charles A. Oravetz
Chief, Marine Mammals and
Endangered Species Branch

cc: FWS, Jackson, MS
Enclosures

Endangered and Threatened Species and Critical Habitat
Under NMFS Jurisdiction

Lower Mississippi River, Louisiana

| LISTED SPECIES | Scientific Name | Status | Date Listed |
|---|---|---|---|
| Green Sea Turtle | Chelonia mydas | Th | 7/8/78 |
| Kemp's(Atlantic) Ridley Sea Turtle | Lepidochelys kempi | E | 12/2/70 |
| Loggerhead Sea Turtle | Caretta caretta | Th | 7/28/78 |

SPECIES PROPOSED FOR LISTING
None

CRITICAL HABITAT
None

CRITICAL HABITAT PROPOSED FOR LISTING
None

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southeast Region
9450 Koger Boulevard
St. Petersburg, FL 33702

June 7, 1983

Mr. Cletis R. Wagahoff
Chief, Planning Division
New Orleans District, Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160

Dear Mr. Wagahoff:

This responds to your June 1, 1983, letter requesting a time extension for completion of the biological assessment (BA) for the Mississippi River, Baton Rouge to the Gulf, GDM Supplement No. 2, Louisiana, project. Your request is made pursuant to provisions of Section 7 of the Endangered Species Act of 1973.

We have no objections to a time extension for completion of the BA and concur with your proposal to include the BA as an appendix to the draft supplement EIS scheduled for distribution in December 1983.

If you have not already done so, the Fish and Wildlife Service should be contacted for a time extension relative to species under their purview.

Sincerely yours,

Charles A. Oravetz

Charles A. Oravetz, Chief
Protected Species Management Branch

cc: FWS, Jackson, MS

MISSISSIPPI RIVER, BATON ROUGE TO THE GULF,
LOUISIANA, PROJECT

DRAFT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT II

APPENDIX C
CULTURAL RESOURCES

APRIL, 1984

# APPENDIX C

## CULTURAL RESOURCES

This appendix contains a description of the methodology used to conduct the cultural resources survey of the Mississippi River navigational channel between Venice, Louisiana and the Gulf of Mexico. Table C-1, displays the positions of all anomalies discovered during the survey. None of these anomalies would be impacted by the recommended project features.

## DESCRIPTION OF SURVEY

The survey crew of four proved to be adequate and included: a boat operator, a seafloor mapping system operator, a positioning system operator, and a depth sounder operator. In actual operation, a track indicator which was mounted near the helmsman's position showed not only the starboard/port orientation of the vessel on the desired track line, but also the percentage of the track line run at any specified time. The start and end x-y positions of each track line were entered into the memory of the positioning system microprocessor as the survey vessel neared the beginning of a particular track line. There proximity could be observed on the track line indicator and the boat operator could call out the beginning of that line. At this signal, all equipment was started with complete synchronization insured by the internal clocks contained within each device.

A problem which developed repeatedly was the termination of a run by either an obstruction in the survey path or debris in the water, forcing some form of evasive action on the part of the boat operator. The terminated line was resumed by circling away from the hazard and rejoining the track line below the point of termination. By observing the track line indicator just before termination and noting the position displayed by the Motorola system, it was possible to resume the survey at approximately the point where it had been terminated.

In laying out the survey grid, it was decided that the reference line would be in the topmost or upper third of the grided area. This arbitary choice produced lines one through seven to the south, one being the reference line, and lines eight through eleven to the north of the reference line. Since the lines were run only in the upstream direction, some time was lost in having to return to the baseline before another run could be made. During each run, crew members maintained a constant monitoring of the equipment. At certain intervals, event marks

were logged and compared to depth sounder charts and positioning readings allowing some interactive guidance of the survey's progress.

The positioning system used required that two or more remote transponders, or reference stations be placed at known locations allowing the triangulation necessary to determine the position to be calculated. Moreover, these positions had to be located in certain optimal areas, areas which would provide a good field of view for the microwave transmission patterns resulting throughout the survey grid area. The nature of this method of survey requires an understanding of the system. The heights of the reference stations above the water and the height of the receiver/transmitter located on a mast on the boat require careful experimentation to ensure proper operation of the system. Multipath interference was a constant problem in the survey area. This was due in part to the great number of vessels using this area as an anchorage area. Multipath interference requires a large number of reflective surfaces, this includes the water over and through which the signals travel. This reflectance produces varying lengths of signal path producing error or even a cancellation of a measurable signal altogether.

Calibration of the reference stations was required prior to the actual fieldwork. This entailed setting up a known range and noting the differences between various reference stations. There exists a minimum range over which the system must be tested; in this instance, no less than 100 meters could be used. By alternating the two reference stations used in the survey, it was possible to show the exact difference between them. The relative difference in this case was -50.8 for station number 1 and -75.4 for station number 2. These numbers are stored in the Motorola Positioning system and the variation is automatically compensated for in the calculation stage. Without this preparation, most data produced are useless.

The calibration table produced was limited to just the two stations; however, the system can handle up to 16 codes and respective site selections. This enables, for example, large reaches of the river to be covered without resetting stations constantly. With the range of these stations being 20 miles in optimum conditions and a realistic usable range of 10 miles in harsh, interference ridden river conditions, this computes to a maximum survey length of 150 miles. In actual practice, this would be difficult in that reference stations themselves and the two 12-volt batteries necessary for their operation are prime targets for theft and vandalism. At approximately seven thousand dollars per station, not including the batteries, this becomes a significant problem. Chains and padlocks were used in this survey along with an augur type anchor; yet any persistence could easily have overcome these obstacles.

Another element of the Motorola system was the coding of the reference stations. Coding relates to the differentiation of one reference station from another; since identical signals are produced by all 16 possible reference stations, it becomes necessary to assign to each station its own frequency by which the Motorola console identifies the particular station which it is required to receive. Two stations were used, these were coded as Station 1 on the east bank and Station 3 on the west bank. Another requirement of the system is the establishment of site designations for the coded reference station locations. In this case, code 1 was designated Site A and code 3 station was Site B.

During the survey, a constant watch over these factors was necessary. In moving from one location to another, reference stations were relocated; this would require repositioning with predetermined coordinates and again experimenting with alternative sites for placement of the remotes. After a time in the field, a familiarity with the system enabled a more rapid placement of these stationary units and the mobile R/T.

Another problem which developed during the first runs in the survey was the fact that the digital tape deck supplied with the seafloor mapping system was setup to operate at a rate of 800 bits per inch. This very low density requires fast tape speeds, and this used up 1,800-foot tape reels at a rate of a reel per 30 minutes of survey. Most nine track tape decks can operate at bit per inch densities of over 6,800 bpi, allowing a major reduction in the speed of the real time recordings.

This short recording time forced the frequent interruption of survey lines in order that tape reels might be changed. Much time could have been saved had the system allowed longer recording times. Also, the smooth flow of the individual track lines could have been maintained.

The total system used throughout this survey involved four separate types of equipment. The seafloor mapping system was supplied by Harvey Lynch of Houston and was made by EG&G. The positioning system was, as mentioned above, a Motorola Mini-Ranger IV using one R/T rather than the possible two, which could have simplified the space diversity problems somewhat. The magnetometers were manufactured by Geometrics, two were used; one was the 856 as a background gamma level monitor, and the other was 866 as the active survey system. The Corps of Engineer's work boat (W-45) was equipped with a Ross Fathometer, which recorded its information by means of a strip chart.

At the outset of the survey, ideal positions for the remote units were determined from charts of the river. The locations were plotted on Corps of Engineers' maps, and known existing positions near these positions were marked for later field examination. The locations of these spots were determined by a formula which produced the lowest factor of error possible. This reduction of error by use of most strategically placed remote locations lead to a higher accuracy than

would be expected if convenient but poorly located sites had been used. Part of the difficulty in this area, as was mentioned above, was the proximity of large ocean-going vessels and their constant movement from day to day. This made it difficult to predict whether a remote site was well chosen. The ability of the positioning system to thread its way through all these obstructions was truly amazing.

A word of explanation is necessary regarding the mention of the reference magnetometer. Using a remote auto recording magnetometer allowed the monitoring of background activity, both in the atmosphere and in the immediate area of the survey. After the day's survey had been completed, this remote magnetometer was digitally dumped into the memory of a small Hewlett-Packard 85 microcomputer. Later on in the course of the data reduction, this reference material could be added to the survey data by means of the appropriate software. The particular software used in this case was supplied by Geometrics and was designed to be used for the combining of various data sources and either averaging or summing this information.

All electronic distance measuring devices work on the basic premise that the transit time of electromagnetic energy from source to receiver will be constant for most practical purposes, whether radio frequency or microwave. Thus, by measuring the transit time of a radio frequency or microwave signal between two points, it is possible to determine the distance between them. In air medium, which occurs in all hydrographic survey applications, the velocity will be slightly slower than in a vacuum. Commercial electronic DME is calibrated at standardized atmospheric conditions for temperature, pressure, and humidity. In field use, these parameters may vary widely and cause very minor changes in calibration. Where the highest accuracy is needed, the transmission path can be monitored for these parameters, and the appropriate corrections can be computed. Regular checks of DME accuracy can be made by comparing the boat position at known locations with the positioning

equipment readings. Some types require periodic adjustment to compensate for minor drift in the equipment.

Data from the best DME will be inadequate if the system is used without carefully checking the geometry of the operating area. When used with care, an electronic DME system can deliver static positioning accuracy that approaches the basic range accuracy of the equipment. In this case, the equipment was claimed to have a two-meter accuracy in optimal conditions. For this type of equipment, the horizontal accuracy of a given static data position depends on the angle of the range intercepts. The greatest position accuracy occurs when range vectors intersect at right angles. This condition is illustrated in Figure 1. With right-angle intercepts, the zone of uncertainty (the cross-hatched area in Figure 1) is approximately square and has worst-case inaccuracies of approximately the square root of two times the basic range accuracy. The maximum inaccuracies occur at the corners of the uncertainty zone where the range inacuracies can combine to give the worst-case condition.

As the angle of intercept moves away from 90 degrees in either direction, the zone of uncertainty becomes larger. For example, if the angle of intercept decreases to 30 degrees as shown in Figure 2, the zone of uncertainty becomes a roughly rhombic-shaped figure, the worst-case condition then shows the positioning error (pe) to be approximately range error (re) divided by the angle of intercept over 2. For a 30-degree intercept, the pe is almost four times the re. As the angle of intercept becomes smaller, the error increases rapidly. It should be noted that the maximum uncertainty occurs along one axis - not both - and this fact should be considered when selecting a shore (reference) station location; for errors in one direction are frequently of less importance than errors in another. Cross-channel errors are usually more significant than longitudinal errors.

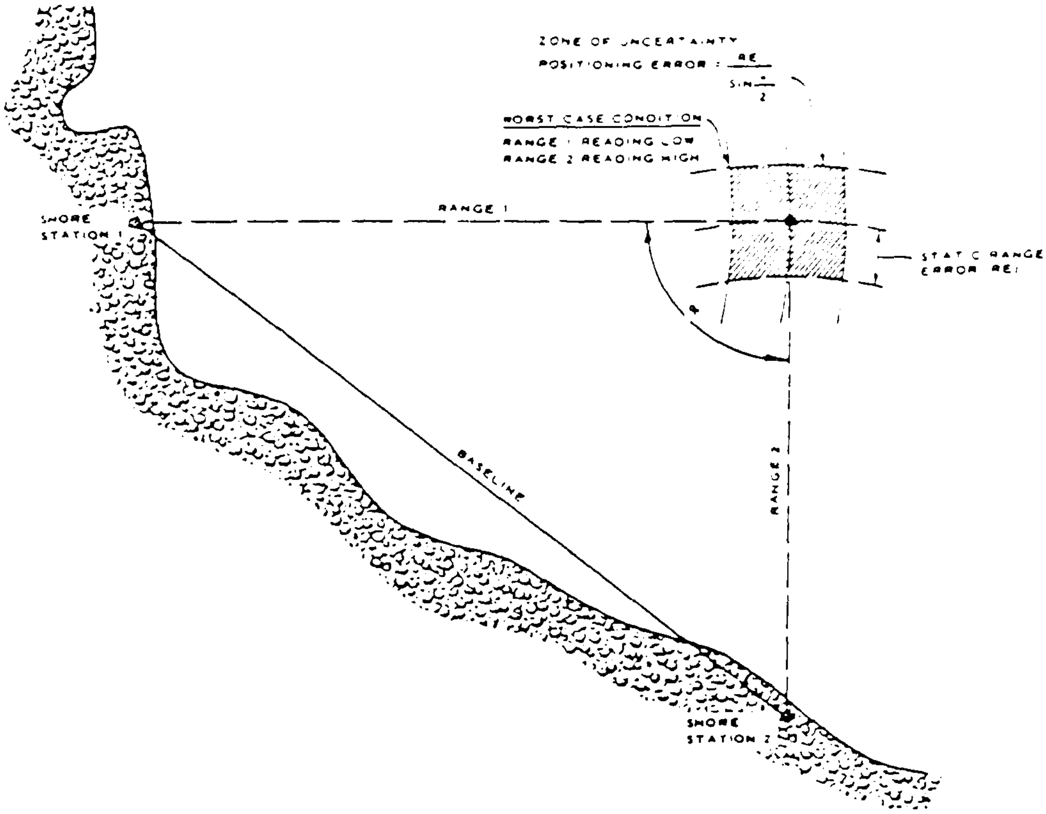


Figure 1. Range intercepts at 90 deg

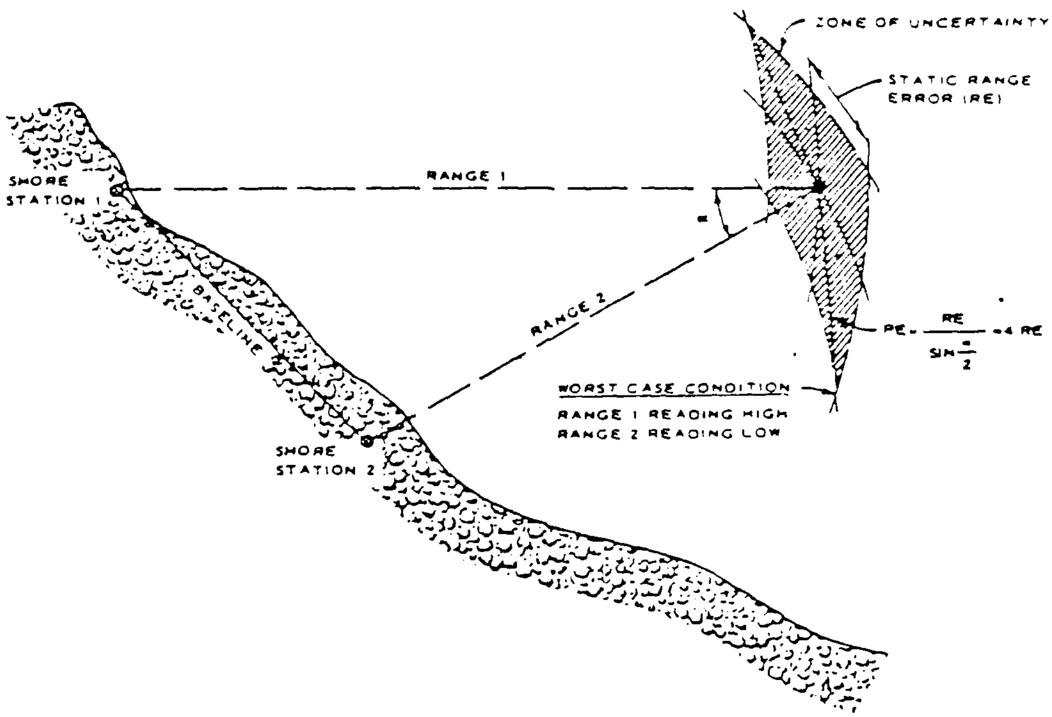


Figure 2. Range intercepts at 30 deg

The location of the reference stations was also a critical point in the operation of the survey. Aside from the geometry of location, height also had to be carefully considered. In the survey, the height of the A-site reference station was approximately 15 feet above the water while at the B-site Station it was 10 feet. The Motorola equipment conveniently compensated for this slant range error through internal programming.

As mentioned above, the choice of reference stations can determine the overall accuracy of the resulting survey. In this area, both height and clear range view were necessary considerations. These facts limited the selection of the shore stations. At the extreme upstream end of the survey area, the zone of uncertainty would have produced a worst-case error of approximately 6 meters along the baseline axis of the survey. This was considered acceptable under the prevailing conditions.

In planning the survey, certain decisions had to be made concerning the types of sites that were possible and which of those could be detectable. Obviously, a small ferromagnetic mass with very little protrusion above the bottom would be extremely difficult to locate. Conversely, a very large mass of ferromagnetic material with extensive protrusion above the bottom would show up well even if the lane spacing were generous. From the standpoint of the Corps of Engineers, a large metal mass in an area to be dredged poses a significant hazard to dredging equipment. From an historic perspective, identification becomes an extremely complex process, and may, in some cases, be unsuccessful entirely.

It was decided that for our purposes a compromise must be obtained by which a gamma threshold of plus or minus 20 gammas and some protrusion above the bottom, as revealed by sonar, would insure closer inspection, and if deemed potentially significant, would be avoided. This compromise would insure that, within the constraints of this

particular effort, all major anomalies could potentially be located. Further, that any missed by this investigation would either fall outside the area of work or be below the depth to which dredging would take place.

The seafloor mapping system employed, allowed a variety of lane spacings, from 75 to 600 meters. A lane spacing of 100 meters was chosen as optimal. This would allow a good overlap for the area to be dredged. A percentage of overlap between the track lines was necessary to allow a match between the two maps produced by the system.

TABLE C-1

LOCATIONS OF ANOMALIES IDENTIFIED DURING A CULTURAL RESOURCE SURVEY OF THE MISSISSIPPI RIVER BELOW VENICE AND SOUTHWEST PASS

| Anomaly | Line | Time | Event | Distance Off-Line | Position X | Position Y |
|---|---|---|---|---|---|---|
| 1 | 02 | 13:22:58 | 0635 | 2ML | 2,629,792 | 123,490 |
| 2 | 02 | 13:24:35 | 0658 | 75ML | 2,630,425 | 124,384 |
| 3 | 01 | 14:19:32 | 0266 | 80ML | 2,622,472 | 112,994 |
| 4 | 01 | 14:37:35 | 0454 | 60MR | 2,623,472 | 113,993 |
| 5 | 01 | 14:37:47 | 0457 | 73MR | 2,633,474 | 113,999 |
| 6 | 01 | 14:37:55 | 0459 | 80MR | 2,633,474 | 113,999 |
| 7 | 01(T-12) | 15:11:30 | 0802 | 20MR | 2,634,142 | 129,845 |
| 8 | 02(WL) | 12:31:54 | 0480 | 10MR | 2,656,913 | 199,011 |
| 9 | 02 | 12:31:09 | 0471 | identified as pipeline | | |
| 10 | 02 | 12:29:50 | 0453 | 90ML (2) | 2,657,364 | 197,796 |
| 11 | 02 | 12:29:11 | 0446 | identified as pipeline | | |
| 12 | 02 | 12:29:02 | 0444 | 85ML | 2,657,551 | 197,280 |
| 13 | 02 | 12:24:15 | 0377 | 23ML | 2,658,727 | 194,024 |
| 14 | 02 | 12:23:30 | 0366 | 20ML | 2,658,897 | 193,560 |
| 15 | 02 | 12:21:32 | 0337 | 35ML | 2,659,418 | 192,154 |
| 16 | | | identified | | | |
| 17 | 01 | 11:13:15 | 0369 | 15MR | 2,658,387 | 193,376 |
| 18 | 01 | 10:58:41 | 0314 | 60ML | 2,659,235 | 190,924 |
| 19 | 01 | 10:57 | 0305 | 98ML | 2,659,422 | 190,401 |
| 20 | 01 | 10:56:58 | 0292 | 15MR | 2,659,627 | 189,839 |
| 21 | 01 | 10:55:34 | 0273 | 5ML | 2,659,958 | 188,951 |
| 22 | 01 | 10:55:07 | 0267 | identified pipeline | | |
| 23 | 01 | 10:39:20 | 0083 | 15MR | 2,663,079 | 179,227 |
| 24 | 01 | 10:12:02 | 0059 | 18MR | 2,662,249 | 178,004 |
| 25 | 01 | 10:10:54 | 0044 | 12MR | 2,662,033 | 177,225 |
| 26 | 01 | 10:10:42 | 0041 | 20MR | 2,661,999 | 177,084 |
| 27 | 01 | 10:09:33 | 0025 | 10mr | 2,661,798 | 176,310 |
| 28 | 02 | 11:34:19 | 0970 | 30MR | 2,663,011 | 175,021 |
| 29 | 02 | 14:06:43 | 0187 | 20ML | 2,637,931 | 135,407 |
| 30 | 02 | 14:21:01 | 0531 | 40ML | 2,659,753 | 169,645 |

MISSISSIPPI RIVER, BATON ROUGE TO THE GULF,
LOUISIANA, PROJECT

DRAFT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT II

APPENDIX D
RECREATIONAL RESOURCES

APRIL, 1984

AD-A141 213 MISSISSIPPI RIVER BATON ROUGE TO THE GULF LOUISIANA PROJECT SUPPLEMENT II(U) ARMY ENGINEER DISTRICT NEW ORLEANS LA APR 84 3/5

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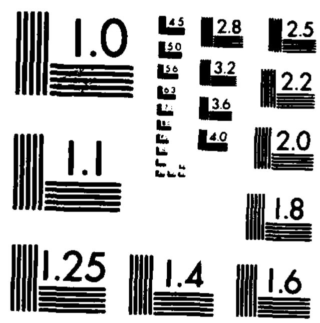


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

# APPENDIX D

# RECREATION

## Hunting Use

Hunting and fishing use was determined and projected in terms of the baseline projection (BP), future-with project conditions (FW), and future-without project conditions (FWOP). Huntable acres by major land or water habitat type were converted to man-days of use per acre by applying the optimal man-days per acre use factors shown on Table D-1.

To calculate hunting and fishing man-days available in the future, various land and water habitat types (fresh marsh, non-fresh marsh, scrub/shrub upland, estuarine water bodies, and river) were projected over 7 construction years and then for the 50-year life of the project for BP, FW and FWOP conditions. The habitat types measured were restricted to those that would be affected by the project. During the first five years of construction, 946 acres of natural levee forest habitat would be lost. Loss of this natural levee forest would eliminate 8,499 big game hunting man-days and 586 small game hunting man-days as displayed in Table D-3. Each habitat type was multiplied by the optimal man-day per acre factor shown in Table D-1. Habitats measured were then totaled to yield the annual man-days of use in the BP, FW and FWOP conditions, by target years. This information is displayed at the bottom of Tables D-2 through D-7. Annual hunting and fishing in the baseline projection during construction and for 50 years of the project life is 779,000 man-days. The future-without project conditions would satisfy 1,212,000 annual man-days of recreation, an increase of 433,000 over the baseline projection. However, in the future-with project condition 919,000 annual man-days of recreational would exist. The recommended project would increase recreational opportunities by 142,000 annual man-days over the baseline projection for the life of the project.

The man-day dollar values establish economic projections when multipled by man-days of use. Table D-8 identifies relative changes in annual hunting and fishing man-days and annual dollar value during the life of the project for the BP, FW and FWOP conditions.

Annualized dollar benefits attributable to the baseline projection are $4,386,000, the FWOP condition would provide annual benefits of $5,817,000, an increase of $1,431,000 over the baseline projection. The recommended FW project would provide annual benefits of $5,016,000 which is an increase of $630,000 over the baseline projection.

TABLE D-1

HUNTING AND FISHING MAN-DAYS PER ACRE BY HABITAT TYPE

| Recreational Activity | Fresh Marsh | Nonfresh Marsh | Estuarine Water Bodies | River | Scrub-Shrub | Natural Levee Forest |
|---|---|---|---|---|---|---|
| Big Game Hunting (Deer) | .24 1/ | .05 1/ | - | - .073 2/ | .073 2/ | |
| Small Game Hunting (Rabbit) | .15 1/ | .09 1/ | - | - .20 2/ | .20 2/ | |
| Waterfowl Hunting | .45 1/ | .31 1/ | N/A 5/ | N/A 5/ | - | - |
| Freshwater Sport Finfishing | 30.80 1/ | 10.25 1/ | N/A 3/ | N/A 4/ | - | - |
| Saltwater Sport Finfishing | 4.19 1/ | 4.19 1/ | N/A 3/ | N/A 4/ | - | - |
| Sport Crabbing | 4.48 1/ | 4.48 1/ | N/A 3/ | N/A 4/ | - | - |
| Sport Shrimping | .28 1/ | .28 1/ | N/A 3/ | N/A 4/ | - | - |

1/ Deep-Draft Access to the Ports of New Orleans and Baton Rouge, Louisiana, Appendix D, Section IV, Page 3, Table 2. Values for non-fresh marsh are averages for the intermediate, brackish, and saline marsh types in Table 2.

2/ Deep-Draft, Appendix D, Section II, Page B-18, Big Game, Small Game Potential Effort/Acre, Man-Day Information

3/ Deep-Draft, Appendix D, Section II Page D-10 (Paragraph 2)

4/ Use Limited, Mainly Used for Access into Marsh

5/ Use Occurs Predominately in Marsh/Pond Area

TABLE D-2

ANNUAL MAN-DAYS AND DOLLAR VALUE BY HABITAT TYPE FOR BASELINE PRODUCTION, FUTURE-WITH PROJECT, AND FUTURE-WITHOUT PROJECT

| 1985 | *Habitat Type | Man-Days Per Acre | BASELINE PROJECTION Acreage | Man-days of Use | Dollar Value Per Man-day | Total Dollar Value | FUTURE-WITH PROJECT Acreage | Man-days of Use | Dollar Value Per Man-Day | Total Dollar Value | FUTURE-WITHOUT PROJECT Acreage | Man-days of Use | Dollar Value Per Man-Day | Total Dollar Value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Large Game Hunting | FM | .24 | 31,683 | 7,604 | $19.00 | $144,476 | 31,683 | 7,604 | $19.00 | $144,476 | 31,683 | 7,604 | $19.00 | $144,476 |
| | NFM | .15 | 21,975 | 3,296 | 19.00 | 62,624 | 21,975 | 3,296 | 19.00 | 62,624 | 21,975 | 3,296 | 19.00 | 62,624 |
| | NLF | .73 | 946 | 691 | 19.00 | 13,129 | 946 | 691 | 19.00 | 13,129 | 946 | 691 | 19.00 | 13,129 |
| | SSU | .73 | 10,041 | 7,330 | 19.00 | 139,270 | 10,041 | 7,330 | 19.00 | 139,270 | 10,041 | 7,330 | 19.00 | 139,270 |
| | EWB | - | 57,832 | - | - | - | 57,832 | - | - | - | 57,832 | - | - | - |
| | R | - | 3,000 | - | - | - | 3,000 | - | - | - | 3,000 | - | - | - |
| Small Game Hunting | FM | .15 | 31,683 | 4,752 | 4.80 | 22,810 | 31,683 | 4,752 | 4.80 | 22,810 | 31,683 | 4,752 | 4.80 | 22,810 |
| | NFM | .29 | 21,975 | 6,372 | 4.80 | 30,586 | 21,975 | 6,372 | 4.80 | 30,586 | 21,975 | 6,372 | 4.80 | 30,586 |
| | NLF | .20 | 946 | 189 | 4.80 | 907 | 946 | 189 | 4.80 | 907 | 946 | 189 | 4.80 | 907 |
| | SSU | .20 | 10,041 | 2,008 | 4.80 | 9,638 | 10,041 | 2,008 | 4.80 | 9,638 | 10,041 | 2,008 | 4.80 | 9,638 |
| | EWB | - | 57,832 | - | - | - | 57,832 | - | - | - | 57,832 | - | - | - |
| | R | - | 3,000 | - | - | - | 3,000 | - | - | - | 3,000 | - | - | - |
| Waterfowl Hunting | FM | .45 | 31,683 | 14,257 | 19.00 | 270,883 | 31,683 | 14,257 | 19.00 | 270,883 | 31,683 | 14,257 | 19.00 | 270,883 |
| | NFM | .92 | 21,975 | 20,217 | 19.00 | 384,123 | 21,975 | 20,217 | 19.00 | 384,123 | 21,975 | 20,217 | 19.00 | 384,123 |
| | NLF | - | 946 | - | - | - | 946 | - | - | - | 946 | - | - | - |
| | SSU | - | 10,041 | - | - | - | 10,041 | - | - | - | 10,041 | - | - | - |
| | EWB | - | 57,832 | - | - | - | 57,832 | - | - | - | 57,832 | - | - | - |
| | R | - | 3,000 | - | - | - | 3,000 | - | - | - | | - | - | - |
| Freshwater Sport Finfishing | FM | 30.8 | 31,683 | 975,836 | 4.80 | 4,684,013 | 31,683 | 975,836 | 4.80 | 4,684,013 | 31,683 | 975,836 | 4.80 | 4,684,013 |
| | NFM | 30.8 | 21,975 | 677 | 4.80 | 3,250 | 21,975 | 677 | 4.80 | 3,250 | 21,975 | 677 | 4.80 | 3,250 |
| | NLF | - | 946 | - | - | - | 946 | - | - | - | 946 | - | - | - |
| | SSU | - | 10,041 | - | - | - | 10,041 | - | - | - | 10,041 | - | - | - |
| | EWB | - | 57,832 | - | - | - | 57,832 | - | - | - | 57,832 | - | - | - |
| | R | - | 3,000 | - | - | - | 3,000 | - | - | - | 3,000 | - | - | - |
| Saltwater Sport Finfishing | FM | 4.19 | 31,683 | 132,752 | 19.00 | 2,522,288 | 31,683 | 132,752 | 19.00 | 2,522,288 | 31,683 | 132,752 | 19.00 | 2,522,288 |
| | NFM | 12.57 | 21,975 | 276,226 | 19.00 | 5,248,294 | 21,975 | 276,226 | 19.00 | 5,248,294 | 21,975 | 276,226 | 19.00 | 5,248,294 |
| | NLF | - | 946 | - | - | - | 946 | - | - | - | 946 | - | - | - |
| | SSU | - | 10,041 | - | - | - | 10,041 | - | - | - | 10,041 | - | - | - |
| | EWB | - | 57,832 | - | - | - | 57,832 | - | - | - | 57,832 | - | - | - |
| | R | - | 3,000 | - | - | - | 3,000 | - | - | - | 3,000 | - | - | - |
| Sport Crabbing | FM | 4.48 | 31,683 | 141,940 | 4.80 | 681,312 | 31,683 | 141,940 | 4.80 | 681,312 | 31,683 | 141,940 | 4.80 | 681,312 |
| | NFM | 12.57 | 21,975 | 295,344 | 4.80 | 1,417,651 | 21,975 | 295,344 | 4.80 | 1,417,651 | 21,975 | 295,344 | 4.80 | 1,417,651 |
| | NLF | - | 946 | - | - | - | 946 | - | - | - | 946 | - | - | - |
| | SSU | - | 10,041 | - | - | - | 10,041 | - | - | - | 10,041 | - | - | - |
| | EWB | - | 57,832 | - | - | - | 57,832 | - | - | - | 57,832 | - | - | - |
| | R | - | 3,000 | - | - | - | 3,000 | - | - | - | 3,000 | - | - | - |
| Sport Shrimping | FM | .28 | 31,683 | 8,871 | 19.00 | 168,548 | 31,683 | 8,871 | 19.00 | 168,548 | 31,683 | 8,871 | 19.00 | 168,548 |
| | NFM | .84 | 21,975 | 18,459 | 19.00 | 350,721 | 21,975 | 18,459 | 19.00 | 350,721 | 21,975 | 18,459 | 19.00 | 350,721 |
| | NLF | - | 946 | - | - | - | 946 | - | - | - | 946 | - | - | - |
| | SSU | - | 10,041 | - | - | - | 10,041 | - | - | - | 10,041 | - | - | - |
| | EWB | - | 57,832 | - | - | - | 57,832 | - | - | - | 57,832 | - | - | - |
| | R | - | 3,000 | - | - | - | 3,000 | - | - | - | 3,000 | - | - | - |
| TOTAL | | | | 1,916,821 | | $16,154,523 | | 1,916,821 | | $16,154,523 | | 1,916,821 | | $16,154,523 |

*FM = Fresh marsh, NFM = Nonfresh marsh, NLF = Natural levee forest, SSU = Scrub-shrub, EWB Estuarine water bodies, R = River

TABLE D-3

ANNUAL MAN-DAYS AND DOLLAR VALUE BY HABITAT TYPE FOR BASELINE PROTECTION, FUTURE-WITH PROJECT, AND FUTURE-WITHOUT PROJECT

| | Habitat Type | Man-Days Per Acre | BASELINE PROJECTION Acreage | BASELINE PROJECTION Man-Days Of Use | BASELINE PROJECTION Dollar Value Per Man-Day | BASELINE PROJECTION Total Dollar Value | FUTURE-WITH PROJECT Acreage | FUTURE-WITH PROJECT Man-Days Of Use | FUTURE-WITH PROJECT Dollar Value Per Man-Day | FUTURE-WITH PROJECT Total Dollar Value | FUTURE-WITHOUT PROJECT Acreage | FUTURE-WITHOUT PROJECT Man-Days Of Use | FUTURE-WITHOUT PROJECT Dollar Value Per Man-Day | FUTURE-WITHOUT PROJECT Total Dollar Value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1985** | | | | | | | | | | | | | | |
| Large Game | NLF | .73 | 946 | 691 | $19.00 | $13,129 | 946 | 691 | $19.00 | $13,129 | 946 | 691 | $19.00 | $13,129 |
| Small Game | NLF | .20 | 946 | 189 | 4.80 | 908 | 946 | 189 | 4.80 | 908 | 946 | 189 | 4.80 | 908 |
| Total | | | | 880 | | 14,037 | | 880 | | 14,037 | | 880 | | 14,037 |
| **1986** | | | | | | | | | | | | | | |
| Large Game | NLF | .73 | 746 | 545 | 19.00 | 10,355 | 656 | 479 | 19.00 | 9,101 | 746 | 545 | 19.00 | 10,355 |
| Small Game | NLF | .20 | 746 | 149 | 4.80 | 715 | 656 | 129 | 4.80 | 619 | 746 | 149 | 4.80 | 715 |
| Total | | | | 694 | | 11,070 | | 608 | | 9,720 | | 694 | | 11,070 |
| **1987** | | | | | | | | | | | | | | |
| Large Game | NLF | .73 | 546 | 399 | 19.00 | 7,573 | 366 | 267 | 19.00 | 5,073 | 546 | 399 | 19.00 | 7,573 |
| Small Game | NLF | .20 | 546 | 109 | 4.80 | 523 | 366 | 73 | 4.80 | 350 | 546 | 109 | 4.80 | 523 |
| Total | | | | 508 | | 8,096 | | 340 | | 5,423 | | 508 | | 8,096 |
| **1988** | | | | | | | | | | | | | | |
| Large Game | NLF | .73 | 346 | 253 | 19.00 | 4,807 | 76 | 55 | 19.00 | 1,045 | 346 | 253 | 19.00 | 4,807 |
| Small Game | NLF | .20 | 346 | 69 | 4.80 | 331 | 76 | 46 | 4.80 | 221 | 346 | 69 | 4.80 | 331 |
| Total | | | | 322 | | 5,138 | | 101 | | 1,266 | | 322 | | 5,138 |
| **1989** | | | | | | | | | | | | | | |
| Large Game | NLF | .73 | 146 | 107 | 19.00 | 2,033 | 0 | 0 | 19.00 | 0 | 146 | 107 | 19.00 | 2,033 |
| Small Game | NLF | .20 | 146 | 29 | 4.80 | 139 | 0 | 0 | 4.80 | 0 | 146 | 29 | 4.80 | 139 |
| Total | | | | 136 | | 2,172 | | | | | | 136 | | 2,172 |

TABLE D-4

ANNUAL MAN-DAYS AND DOLLAR VALUE BY HABITAT TYPE FOR BASELINE PROJECTION, FUTURE-WITH PROJECT, AND FUTURE-WITHOUT PROJECT

| 1992 | Habitat Type | Man-Days Per Acre | BASELINE PROJECTION Acreage | BASELINE PROJECTION Man-Days Of Use | BASELINE PROJECTION Dollar Value Per Man-Day | BASELINE PROJECTION Total Dollar Value | FUTURE-WITH PROJECT Acreage | FUTURE-WITH PROJECT Man-Days Of Use | FUTURE-WITH PROJECT Dollar Value Per Man-Day | FUTURE-WITH PROJECT Total Dollar Value | FUTURE-WITHOUT PROJECT Acreage | FUTURE-WITHOUT PROJECT Man-Days Of Use | FUTURE-WITHOUT PROJECT Dollar Value Per Man-Day | FUTURE-WITHOUT PROJECT Total Dollar Value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Large Game Hunting | FM | .24 | 25,149 | 6,036 | $19.00 | $114,684 | 25,688 | 6,165 | $19.00 | $117,135 | 25,616 | 6,148 | $19.00 | $116,812 |
| | NFM | .15 | 17,066 | 2,560 | 19.00 | 48,640 | 19,442 | 2,961 | 19.00 | 56,259 | 18,922 | 2,838 | 19.00 | 53,922 |
| | SSU | .73 | 12,015 | 8,771 | 19.00 | 166,648 | 13,515 | 9,866 | 19.00 | 187,454 | 13,000 | 9,490 | 19.00 | 180,310 |
| | EWB | - | 67,301 | - | - | - | 62,886 | - | - | - | 63,993 | - | - | - |
| | R | - | 3,042 | - | - | - | 0 | - | - | - | 3,042 | - | - | - |
| Small Game Hunting | FM | .15 | 25,149 | 3,772 | 4.80 | 18,105 | 25,688 | 3,853 | 4.80 | 18,494 | 25,616 | 3,842 | 4.80 | 18,442 |
| | NFM | .29 | 17,066 | 4,949 | 4.80 | 23,755 | 19,442 | 5,638 | 4.80 | 27,062 | 18,922 | 5,487 | 4.80 | 26,338 |
| | SSU | .20 | 12,015 | 2,403 | 4.80 | 11,534 | 13,515 | 2,703 | 4.80 | 12,974 | 13,000 | 2,600 | 4.80 | 12,480 |
| | EWB | - | 67,301 | - | - | - | 62,886 | - | - | - | 63,993 | - | - | - |
| | R | - | 3,042 | - | - | - | 0 | - | - | - | 3,042 | - | - | - |
| Waterfowl Hunting | FM | .45 | 25,149 | 11,317 | 19.00 | 215,023 | 25,688 | 11,560 | 19.00 | 219,640 | 25,616 | 11,527 | 19.00 | 219,013 |
| | NFM | .92 | 17,066 | 15,700 | 19.00 | 298,300 | 19,442 | 17,887 | 19.00 | 339,853 | 18,922 | 17,408 | 19.00 | 330,752 |
| | SSU | - | 12,015 | - | - | - | 13,515 | - | - | - | 13,000 | - | - | - |
| | EWB | - | 67,301 | - | - | - | 62,886 | - | - | - | 63,993 | - | - | - |
| | R | - | 3,042 | - | - | - | 0 | - | - | - | 3,042 | - | - | - |
| Fresh Sport Finfishing | FW | 30.8 | 25,149 | 774,589 | 4.80 | 3,718,027 | 25,688 | 791,190 | 4.80 | 3,797,712 | 25,616 | 788,973 | 4.80 | 3,787,070 |
| | NFM | 30.8 | 17,066 | 525,633 | 4.80 | 2,523,038 | 19,442 | 598,814 | 4.80 | 2,874,307 | 18,922 | 582,798 | 4.80 | 2,797,430 |
| | SSU | - | 12,015 | - | - | - | 13,515 | - | - | - | 13,000 | - | - | - |
| | EWB | - | 67,301 | - | - | - | 62,886 | - | - | - | 63,993 | - | - | - |
| | R | - | 3,042 | - | - | - | 0 | - | - | - | 3,042 | - | - | - |
| Saltwater Sport Finfishing | FM | 4.19 | 25,149 | 105,374 | 19.00 | 2,002,106 | 25,688 | 107,633 | 19.00 | 2,045,027 | 25,616 | 107,331 | 19.00 | 2,039,289 |
| | NFM | 12.57 | 17,066 | 214,520 | 19.00 | 4,075,880 | 19,442 | 244,386 | 19.00 | 4,643,334 | 18,922 | 237,850 | 19.00 | 4,519,150 |
| | SSU | - | 12,015 | - | - | - | 13,515 | - | - | - | 13,000 | - | | - |
| | EWB | - | 67,301 | - | - | - | 62,886 | - | - | - | 63,993 | - | | - |
| | R | - | 3,042 | - | - | - | 0 | - | - | - | 3,042 | - | | - |
| Sport Crabbing | FM | 4.48 | 25.149 | 112.668 | 4.80 | 540,806 | 25,688 | 115,082 | 4.80 | 552,394 | 25,616 | 114,760 | 4.80 | 550,848 |
| | NFM | 13.44 | 17,066 | 229,367 | 4.80 | 1,100,961 | 19,442 | 261,300 | 4.80 | 1,254,240 | 18,922 | 254,312 | 4.80 | 1,220,698 |
| | SSU | - | 12,015 | - | - | - | 13,515 | - | - | - | 13,000 | - | - | - |
| | EWB | - | 67,301 | - | - | - | 62,886 | - | - | - | 63,993 | - | - | - |
| | R | - | 3,042 | - | - | - | 0 | - | - | - | 3,042 | - | - | - |
| Sport Shrimping | FM | .28 | 25,149 | 7,042 | 19.00 | 133,798 | 25,688 | 7,193 | 19.00 | 136,667 | 25,616 | 7,172 | 19.00 | 136,268 |
| | NFM | .84 | 17,066 | 14,335 | 19.00 | 277,365 | 19,442 | 16,331 | 19.00 | 310,289 | 18,922 | 15,894 | 19.00 | 301,986 |
| | SSU | - | 12,015 | - | - | - | 13,515 | - | - | - | 13,000 | - | - | - |
| | EWB | - | 67,301 | - | - | - | 62,886 | - | - | - | 63,993 | - | - | - |
| | R | - | 3,042 | - | - | - | 0 | - | - | - | 3,042 | - | - | - |
| TOTAL | | | | 2,039,036 | | $15,236,670 | | 2,202,562 | | $16,592,841 | | 2,168,430 | | $16,310,808 |

TABLE D-5

ANNUAL MAN-DAYS AND DOLLAR VALUE BY HABITAT TYPE FOR BASELINE PROJECTION, FUTURE-WITH PROJECT, AND FUTURE-WITHOUT PROJECT

| | | | BASELINE PROJECTION | | | | FUTURE-WITH PROJECT | | | | FUTURE-WITHOUT PROJECT | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2006 | Habitat Type | Man-Days Per Acre | Acreage | Man-Days Of Use | Dollar Value Per Man-Day | Total Dollar Value | Acreage | Man-Days Of Use | Dollar Value Per Man-Day | Total Dollar Value | Acreage | Man-Days Of Use | Dollar Value Per Man-Day | Total Dollar Value |
| Large Game Hunting | FW | .24 | 15,965 | 3,832 | $19.00 | $72,808 | 17,461 | 4,191 | $9.00 | $79,629 | 20,239 | 4,857 | $19.00 | $92,238 |
| | NFM | .15 | 10,834 | 1,625 | 19.00 | 30,875 | 20,166 | 3,025 | 19.00 | 57,475 | 16,178 | 2,427 | 19.00 | 46,113 |
| | SSU | .73 | 15,963 | 11,653 | 19.00 | 221,407 | 13,799 | 10,073 | 19.00 | 191,387 | 19,687 | 14,372 | 19.00 | 273,068 |
| | EWB | - | 78,769 | - | - | - | 70,105 | - | - | - | 65,427 | - | - | - |
| | R | - | 3,127 | - | - | - | 0 | - | - | - | 3,127 | - | - | - |
| Small Game Hunting | FW | .15 | 15,965 | 2,395 | 4.80 | 11,496 | 17,461 | 2,619 | 4.80 | 12,571 | 20,239 | 3,036 | 4.80 | 14,573 |
| | NFM | .29 | 10,834 | 3,142 | 4.80 | 15,082 | 20,166 | 5,848 | 4.80 | 28,070 | 16,178 | 4,962 | 4.80 | 22,522 |
| | SSU | .20 | 15,963 | 3,193 | 4.80 | 15,326 | 13,799 | 2,760 | 4.80 | 13,248 | 19,687 | 3,937 | 4.80 | 18,898 |
| | EWB | - | 78,769 | - | - | - | 70,105 | - | - | - | 65,427 | - | - | - |
| | R | - | 3,127 | - | - | - | 0 | - | - | - | 3,127 | - | - | - |
| Waterfowl Hunting | FW | .45 | 15,965 | 7,184 | 19.00 | 136,496 | 17,461 | 7,857 | 19.00 | 149,283 | 20,239 | 9,106 | 19.00 | 173,014 |
| | NFM | .92 | 10,834 | 9,967 | 19.00 | 189,373 | 20,166 | 18,553 | 19.00 | 352,507 | 16,178 | 14,884 | 19.00 | 282,796 |
| | SSU | - | 15,963 | - | - | - | 13,799 | - | - | - | 19,687 | - | - | - |
| | EWB | - | 78,769 | - | - | - | 70,105 | - | - | - | 65,427 | - | - | - |
| | R | - | 3,127 | - | - | - | 0 | - | - | - | 3,127 | - | - | - |
| Fresh Sport Finfishing | FW | 30.8 | 15,965 | 491,722 | 4.80 | 2,360,266 | 17,461 | 237,799 | 4.80 | 1,141,435 | 20,239 | 623,361 | 4.80 | 2,992,133 |
| | NFM | 30.8 | 10,834 | 333,687 | 4.80 | 1,601,698 | 20,166 | 621,113 | 4.80 | 2,981,342 | 16,178 | 498,282 | 4.80 | 2,391,754 |
| | SSU | - | 15,963 | - | - | - | 13,799 | - | - | - | 19,687 | - | - | - |
| | EWB | - | 78,769 | - | - | - | 70,105 | - | - | - | 65,427 | - | - | - |
| | R | - | 3,127 | - | - | - | 0 | - | - | - | 3,127 | - | - | - |
| Saltwater Sport Finfishing | FW | 4.19 | 15,965 | 66,893 | 19.00 | 1,270,967 | 17,461 | 73,162 | 19.00 | 1,390,078 | 20,239 | 84,801 | 19.00 | 435,221 |
| | NFM | 12.57 | 10,834 | 136,183 | 19.00 | 2,587,477 | 20,166 | 253,487 | 19.00 | 4,816,253 | 16,178 | 203,357 | 19.00 | 3,863,783 |
| | SSU | - | 15,963 | - | - | - | 13,799 | - | - | - | 19,687 | - | - | - |
| | EWB | - | 78,769 | - | - | - | 70,105 | - | - | - | 65,427 | - | - | - |
| | R | - | 3,127 | - | - | - | 0 | - | - | - | 3,127 | - | - | - |
| Sport Crabbing | FW | 4.48 | 15,965 | 71,523 | 4.80 | 343,310 | 17,461 | 78,225 | 4.80 | 375,480 | 20,239 | 90,671 | 4.80 | 435,221 |
| | NFM | 13.44 | 10,834 | 145,609 | 4.80 | 698,923 | 20,466 | 271,031 | 4.80 | 1,300,949 | 16,178 | 217,432 | 4.80 | 1,043,674 |
| | SSU | - | 15,963 | - | - | - | 13,799 | - | - | - | 19,687 | - | - | - |
| | EWB | - | 78,769 | - | - | - | 70,105 | - | - | - | 65,427 | - | - | - |
| | R | - | 3,127 | - | - | - | 0 | - | - | - | 3,127 | - | - | - |
| Sport Shrimping | FW | .28 | 15,965 | 4,470 | 19.00 | 84,930 | 17,461 | 4,889 | 19.00 | 92,891 | 20,139 | 5,667 | 19.00 | 107,673 |
| | NFM | .84 | 10,834 | 9,101 | 19.00 | 172,919 | 20,166 | 16,939 | 19.00 | 321,841 | 16,178 | 13,590 | 19.00 | 258,210 |
| | SSU | - | 15,963 | - | - | - | 13,799 | - | - | - | 19,687 | - | - | - |
| | EWB | - | 78,769 | - | - | - | 70,105 | - | - | - | 65,427 | - | - | - |
| | R | - | 3,127 | - | - | - | 0 | - | - | - | 3,127 | - | - | - |
| TOTAL | | | | 1,302,179 | | $9,813,353 | | 1,611,571 | | $13,304,439 | | 1,794,472 | | $13,626,934 |

TABLE D-6

ANNUAL MAN-DAYS AND DOLLAR VALUE BY HABITAT TYPE FOR BASELINE PROJECTION, FUTURE-WITH PROJECT, AND FUTURE-WITHOUT PROJECT

| 2017 | Habitat Type | Man-Days Per Acre | BASELINE PROJECTION Acreage | Man-Days Of Use | Dollar Value Per Man-Day | Total Dollar Value | FUTURE-WITH PROJECT Acreage | Man-Days Of Use | Dollar Value Per Man-Day | Total Dollar Value | FUTURE-WITHOUT PROJECT Acreage | Man-Days Of Use | Dollar Value Per Man-Day | Total Dollar Value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Large Game Hunting | FM | .24 | 11,171 | 2,681 | 19.00 | 50,939 | 13,191 | 3,166 | 19.00 | 60,154 | 19,503 | 4,681 | 19.00 | 88,939 |
| | NFM | .15 | 7,581 | 1,137 | 19.00 | 21,603 | 15,011 | 2,252 | 19.00 | 42,788 | 15,959 | 2,394 | 19.00 | 45,486 |
| | SSU | .73 | 19,065 | 13,917 | 19.00 | 264,423 | 16,901 | 12,338 | 19.00 | 234,422 | 25,925 | 18,925 | 19.00 | 359,575 |
| | EWB | - | 83,714 | - | - | - | 76,428 | - | - | - | 60,144 | - | - | - |
| | R | - | 3,193 | - | - | - | 0 | - | - | - | 3,193 | - | - | - |
| Small Game Hunting | FM | .15 | 11,171 | 1,676 | 4.80 | 8,045 | 13,191 | 1,979 | 4.80 | 9,499 | 19,503 | 2,925 | 4.80 | 14,040 |
| | NFM | .29 | 7,581 | 2,198 | 4.80 | 10,550 | 15,011 | 4,353 | 4.80 | 20,894 | 15,959 | 4,628 | 4.80 | 22,214 |
| | SSU | .20 | 19,065 | 3,813 | 4.80 | 18,302 | 16,901 | 3,380 | 4.80 | 16,224 | 25,925 | 5,185 | 4.80 | 24,888 |
| | EWB | - | 83,714 | - | - | - | 76,428 | - | - | - | 60,144 | - | - | - |
| | R | - | 3,193 | - | - | - | 0 | - | - | - | 3,193 | - | - | - |
| Waterfowl Hunting | FM | .45 | 11,171 | 5,027 | 19.00 | 95,513 | 13,191 | 5,936 | 19.00 | 112,784 | 19,503 | 8,776 | 19.00 | 166,744 |
| | NFM | .92 | 7,581 | 6,975 | 19.00 | 132,525 | 15,011 | 13,810 | 19.00 | 262,390 | 15,959 | 14,682 | 19.00 | 278,958 |
| | SSU | - | 19,065 | - | - | - | 16,901 | - | - | - | 25,925 | - | - | - |
| | EWB | - | 83,714 | - | - | - | 76,428 | - | - | - | 60,144 | - | - | - |
| | R | | 3,193 | - | - | - | 0 | - | - | - | 3,193 | - | - | - |
| Fresh Sport Finfishing | FM | 30.80 | 11,171 | 344,067 | 4.80 | 1,651,522 | 13,191 | 406,283 | 4.80 | 1,950,158 | 19,503 | 600,692 | 4.82 | 2,883,322 |
| | NFM | 30.80 | 7,581 | 233,495 | 4.80 | 1,120,776 | 15,011 | 462,339 | 4.80 | 2,219,227 | 15,959 | 491,537 | 4.80 | 2,359,378 |
| | SSU | - | 19,065 | - | - | - | 16,901 | - | - | - | 25,925 | - | - | - |
| | EWB- | - | 83,714 | - | - | - | 76,428 | - | - | - | 60,144 | - | - | - |
| | R | - | 3,193 | - | - | - | 0 | - | - | - | 3,193 | - | - | - |
| Saltwater Sport Finfishing | FM | 4.19 | 11,171 | 46,806 | 19.00 | 889,314 | 13,191 | 55,270 | 19.00 | 1,050,130 | 19,503 | 51,718 | 19.00 | 982,642 |
| | NFM | 12.57 | 7,581 | 95,293 | 19.00 | 1,810,567 | 15,011 | 188,688 | 19.00 | 3,585,072 | 15,959 | 200,605 | 19.00 | 3,811,495 |
| | SSU | - | 19,065 | - | - | - | 16,901 | - | - | - | 25,925 | - | - | - |
| | EWB | - | 83,714 | - | - | - | 76,428 | - | - | - | 60,144 | - | - | - |
| | R | - | 3,193 | - | - | - | 0 | - | - | - | 3,193 | - | - | - |
| Sport Crabbing | FM | 4.48 | 11,171 | 50,046 | 4.80 | 240,221 | 13,191 | 59,096 | 4.80 | 283,661 | 19,503 | 87,373 | 4.80 | 419,390 |
| | NFM | 13.44 | 7,581 | 101,889 | 4.80 | 489,067 | 15,011 | 201,748 | 4.80 | 968,390 | 15,959 | 214,489 | 4.80 | 1,029,547 |
| | SSU | - | 19,065 | - | - | - | 16,901 | - | - | - | 25,925 | - | - | - |
| | EWB | - | 83,714 | - | - | - | 76,428 | - | - | - | 60,144 | - | - | - |
| | R | - | 3,193 | - | - | - | 0 | - | - | - | 3,193 | - | - | - |
| Sport Shrimping | FM | .28 | 11,171 | 3,128 | 19.00 | 59,432 | 13,191 | 3,693 | 19.00 | 70,167 | 19,503 | 5,461 | 19.00 | 103,759 |
| | NFM | .84 | 7,581 | 6,368 | 19.00 | 120,992 | 15,011 | 12,609 | 19.00 | 239,571 | 15,959 | 13,406 | 19.00 | 254,714 |
| | SSU | - | 19,065 | - | - | - | 16,901 | - | - | - | 25,925 | - | - | - |
| | EWB | - | 83,714 | - | - | - | 76,428 | - | - | - | 60,144 | - | - | - |
| | R | - | 3,193 | - | - | - | 0 | - | - | - | 3,193 | - | - | - |
| TOTAL | | | | 918,516 | | $6,983,791 | | 1,436,940 | | $11,125,531 | | 1,727,479 | | $12,845,091 |

TABLE D-7

ANNUAL MAN DAYS AND DOLLAR VALUE BY HABITAT TYPE FOR BASELINE PROJECTION, FUTURE WITH-PROJECT, AND FUTURE-WITHOUT PROJECT

| 2042 | Habitat Type | Man-Days Per Acre | BASELINE PROJECTION Acreage | Man-Days Of Use | Dollar Value Per Man-Day | Total Dollar Value | FUTURE-WITH PROJECT Acreage | Man-Days Of Use | Dollar Value Per Man-Day | Total Dollar Value | FUTURE-WITHOUT PROJECT Acreage | Man-Days Of Use | Dollar Value Per Man-Day | Total Dollar Value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Large Game Hunting | FM | .24 | 4,962 | 1,191 | $19.00 | $22,629 | 8,030 | 1,927 | $19.00 | $36,613 | 19,523 | 4,686 | $19.00 | $89,034 |
| | NFM | .15 | 3,367 | 505 | 19.00 | 9,595 | 13,927 | 2,089 | 19.00 | 39,691 | 17,179 | 2,577 | 19.00 | 48,963 |
| | SSU | .73 | 26,115 | 19,064 | 19.00 | 362,216 | 23,951 | 17,484 | 19.00 | 322,196 | 40,173 | 29,326 | 19.00 | 557,194 |
| | EWB | - | 87,087 | - | - | - | 75,623 | - | - | - | 44,656 | - | - | - |
| | R | - | 3,344 | - | - | - | 0 | - | - | - | 3,344 | - | - | - |
| Small Game Hunting | FM | .15 | 4,962 | 7,443 | 4.80 | 35,726 | 8,030 | 1,250 | 4.80 | 5,784 | 19,523 | 2,928 | 4.80 | 14,054 |
| | NFM | .29 | 3,367 | 976 | 4.80 | 4,685 | 13,927 | 4,039 | 4.80 | 19,387 | 17,179 | 4,982 | 4.80 | 23,914 |
| | SSU | .20 | 26,115 | 5,223 | 4.80 | 25,070 | 23,951 | 4,790 | 4.80 | 22,992 | 40,173 | 8,035 | 4.80 | 38,568 |
| | EWB | - | 87,087 | - | - | - | 75,623 | - | - | - | 44,656 | - | - | - |
| | R | - | 3,344 | - | - | - | 0 | - | - | - | 3,344 | - | - | - |
| Waterfowl Hunting | FM | .45 | 4,962 | 2,233 | 19.00 | 24,427 | 8,030 | 3,614 | 19.00 | 68,666 | 19,523 | 8,785 | 19.00 | 166,915 |
| | NFM | .92 | 3,367 | 3,098 | 19.00 | 58,862 | 13,927 | 12,813 | 19.00 | 243,447 | 17,179 | 15,805 | 19.00 | 300,295 |
| | SSU | - | 26,115 | - | - | - | 23,951 | - | - | - | 40,173 | - | - | - |
| | EWB | - | 87,087 | - | - | - | 75,623 | - | - | - | 44,656 | - | - | - |
| | R | - | 3,344 | - | - | - | 0 | - | - | - | 3,344 | - | - | - |
| Fresh Sport Pinfishing | FM | 30.80 | 4,962 | 152,830 | 4.80 | 733,584 | 8,030 | 247,324 | 4.80 | 1,187,155 | 19,523 | 601,308 | 4.80 | 2,886,278 |
| | NFM | 30.80 | 3,367 | 103,704 | 4.80 | 497,779 | 13,927 | 428,957 | 4.80 | 2,058,994 | 17,179 | 529,113 | 4.80 | 2,539,742 |
| | SSU | - | 26,115 | - | - | - | 23,951 | - | - | - | 40,173 | - | - | - |
| | EWB | - | 87,087 | - | - | - | 75,623 | - | - | - | 44,656 | - | - | - |
| | R | - | 3,344 | - | - | - | 0 | - | - | - | 3,344 | - | - | - |
| Saltwater Sport Pinfishing | FM | 4.19 | 4,962 | 20,791 | 19.00 | 395,029 | 8,030 | 33,646 | 19.00 | 639,274 | 19,532 | 87,801 | 19.00 | 1,554,219 |
| | NFM | 12.57 | 3,367 | 42,323 | 19.00 | 804,137 | 13,927 | 175,062 | 19.00 | 3,326,178 | 17,179 | 215,940 | 19.00 | 4,102,820 |
| | SSU | - | 26,115 | - | - | - | 23,951 | - | - | - | 40,173 | - | - | - |
| | EWB | - | 87,087 | - | - | - | 75,523 | - | - | - | 44,656 | - | - | - |
| | R | - | 3,344 | - | - | - | 0 | - | - | - | 3,344 | - | - | - |
| Sport Crabbing | FM | 4.48 | 4,962 | 22,230 | 4.80 | 106,704 | 8,030 | 35,974 | 4.80 | 172,675 | 19,532 | 87,463 | 4.80 | 419,822 |
| | NFM | 13.44 | 3,367 | 45,254 | 4.80 | 217,219 | 13,927 | 187,179 | 4.80 | 898,459 | 17,179 | 230,886 | 4.80 | 1,108,253 |
| | SSU | - | 26,115 | - | - | - | 23,951 | - | - | - | 40,173 | - | - | - |
| | EWB | - | 87,087 | - | - | - | 17,623 | - | - | - | 44,656 | - | - | - |
| | R | - | 3,344 | - | - | - | 0 | - | - | - | 3,344 | - | - | - |
| Sport Shrimping | FM | .28 | 4,962 | 1,389 | 19.00 | 26,391 | 8,030 | 2,248 | 19.00 | 42,712 | 19,532 | 5,466 | 19.00 | 103,854 |
| | NFM | .84 | 3,367 | 2,828 | 19.00 | 53,732 | 13,927 | 11,699 | 19.00 | 222,281 | 17,179 | 14,430 | 19.00 | 274,170 |
| | SSU | - | 26,115 | - | - | - | 23,951 | - | - | - | 40,173 | - | - | - |
| | EWB | - | 87,087 | - | - | - | 17,623 | - | - | - | 44,656 | - | - | - |
| | R | - | 3,344 | - | - | - | 0 | - | - | - | 3,344 | - | - | - |
| TOTAL | | | | 431,082 | | $3,377,785 | | 1,170,050 | | $9,316,504 | | 1,843,531 | | $14,228,135 |

## Recreational Dollar Valuations

Due to lack of data necessary to use the Travel Cost or Contingent Values Method to evaluate recreational benefits, the values used in this study were derived from the range of Unit Day Values provided annually by the Water Resources Council (WRC). The value ranges for recreation unit days contained in the WRC Principles and Guidelines for 1983 are:

General Hunting & Fishing $2.30 to $4.80
Specialized Hunting and Fishing $11.20 to $19.00

Value selection from these ranges was determined by using the five criteria and standards that measure relative characteristics and attributes of the project area recreation features.

Differentiating between general and specialized hunting and fishing activities was accomplished by using WRC definitions. Basically, general activities are thought of as those common to an area that are of normal quality. Specialized activities are more extensive in use and relatively unique. For this study, big game hunting (deer), waterfowl hunting, saltwater sport fishing, and sport shrimping are considered specialized while small game hunting (rabbit), freshwater sport finfishing, and sport crabbing are considered general.

Project-related recreational activities were weighed against a suggested rating table provided in WRC Principles and Standards that measures recreation activities offered, available opportunity, carrying capacity, ease of access, and environmental quality. These values were applied to the varied activities in the following manner. General hunting and fishing activities have been determined to have an associated man-day dollar value of $3.10 where specialized hunting and fishing is valued at $12.30 per man-day.

TABLE D-8

ANNUALIZED HUNTING AND FISHING MAN-DAYS AND DOLLARS

| | BASELINE PROJECTION (BP) | | FUTURE-WITH PROJECT (FWP) | | FUTURE-WITHOUT PROJECT (FWOP) | |
|---|---|---|---|---|---|---|
| | Man-Days | Dollars | Man-Days | Dollars | Man-Days | Dollars |
| 1985 1/ | 1,727,326 | 7,908,975 | 1,723,141 | 7,886,535 | 1,720,822 | 7,874,104 |
| 1986 1/ | 1,727,140 | 7,907,056 | 1,722,869 | 7,883,742 | 1,720,636 | 7,872,185 |
| 1987 1/ | 1,726,954 | 7,905,136 | 1,722,601 | 7,880,960 | 1,720,450 | 7,870,265 |
| 1988 1/ | 1,726,768 | 7,903,216 | 1,722,362 | 7,878,270 | 1,720,264 | 7,868,345 |
| 1889 1/ | 1,726,582 | 7,901,296 | 1,722,261 | 7,877,450 | 1,720,078 | 7,866,425 |
| 1992 2/ | 1,367,280 | 6,271,197 | 1,410,931 | 6,521,794 | 1,410,065 | 6,474,906 |
| 2006 2/ | 875,635 | 4,060,133 | 1,048,716 | 4,976,575 | 1,144,788 | 5,267,115 |
| 2017 2/ | 619,949 | 2,915,764 | 754,765 | 3,619,558 | 1,118,267 | 5,137,044 |
| 2042 2/ | 291,536 | 1,462,021 | 488,095 | 2,481,351 | 1,150,798 | 5,300,655 |
| Average Annual Values (Rounded)........ | 779,000 | $4,386,000 | 919,000 | $5,016,000 | 1,212,000 | $5,817,000 |
| | | | (+142,000) 3/ | (+$630,000) 4/ | (+433,000) 5/ | (+$1,431,000) 6/ |

1/ All habitats types, including natural levee forest. All man-day impacts associated with natural levee forest occur within the first five years of construction.
2/ Project life (50 years) all habitat types except natural levee forest.
3/ FWP - BP = FWP annual increase in man-days above the baseline projection.
4/ FWP - BP = FWP annual increase in dollar benefits above the baseline projection.
5/ FWOP - BP = FWOP annual increase in man-days above the baseline projection.
6/ FWOP - BP = FWOP annual increase in dollar benefits above the baseline projection.

MISSISSIPPI RIVER, BATON ROUGE TO THE GULF,
LOUISIANA, PROJECT

DRAFT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT II

APPENDIX E
WATER QUALITY

APRIL, 1984

## APPENDIX E, WATER QUALITY

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APPENDIX E

WATER QUALITY

1.0. INTRODUCTION

1.1. Significant aspects of water quality in the project area (active delta of the Mississippi River) include salinity, nutrients, dissolved oxygen, and pollutants. Each of these aspects is affected by the interaction of river and gulf waters. Therefore, an integral part of the water quality analysis is the river flow distribution south of Venice, Louisiana, and the net circulation patterns in the gulf adjacent to the Mississippi River delta.

1.2. Since the project features would affect the flow distribution throughout the delta, and thereby the water quality aspects, the area of potential impact studied includes the entire delta south of Venice. For convenience, the area is artificially divided into four subunits bisected by the Mississippi River - Southwest Pass navigational channel and by the latitude of Head of Passes (Plate 1).

2.0. EXISTING CONDITIONS

2.1. Existing Flow Distribution in Mississippi River Delta

2.1.1. The Mississippi River drains a basin which covers 41 percent of the 48 contiguous states of the United States and a small portion of Canada. It has a drainage area of 1,234,700 square miles including tributaries. Of this area, 13,000 square miles are in Canada. Tributaries to the river extend from New York in the east to Wyoming and Montana in the west.

2.1.2. The Mississippi River discharges its flow to the Gulf of Mexico via the main stem of the Mississippi River and the Old River Outflow Channel at river mile 314.5 Above Head of Passes (AHP). That portion of the discharge routed through the Old River Channel is routed down the Atchafalaya River to the Gulf of Mexico. Below Old River, there are two floodways which are used to reduce the volume of water in the lower Mississippi River during periods of unusually high discharge. These are the Morganza Floodway located on the right descending (west) bank at river mile 280 AHP and the Bonnet Carre Floodway located on the left descending (east) bank at river mile 128 AHP. Both of these floodways have been used since construction, the Morganza in 1973 and the Bonnet Carre in 1937, 1945, 1950, 1973, 1975, 1979, and 1983.

2.1.3. Except for the flow through these two floodways, when in use, the Mississippi River discharge below the latitude of Old River is essentially the discharge which reaches Venice.

2.1.4. The average discharge on the Mississippi River downstream from the Old River Outflow Channel is approximately 460,000 cubic feet per second (cfs) based on records from 1928 to 1976. The annual mean discharge in this reach of the river has ranged from a low of 243,000 cfs for the 1954 water year to a high of 729,000 cfs for the 1973 water year.

2.1.5. River stages within the project area are affected by river discharges, sustained winds, tides, and hurricane surges.

2.1.6. Hurricane surges were not considered in this study because these surges, while severe, have occurred only an average of once every 5 years in the last century and their duration is usually very short. The severity of the surges caused by hurricanes can be shown by an examination of the stages recorded in August 1969 because of Hurricane Camille when a stage of 15.1 feet was recorded at Venice, Louisiana, at

river mile 10.7 AHP. This compares with a mean stage for August of 1.64 feet. A surge of this magnitude would overtop the proposed training works along both banks of the river creating temporarily altered circulation conditions in the adjacent marshes and wetlands.

2.1.7. River and bay or gulf stages are affected by tides and sustained winds. Tides at the mouth of the river are diurnal; that is, the high and low tides occur once each 24-hour period, and the tides have a mean range of 1.3 feet. The spring range is 2.6 feet and the neap range is 0.1 feet. Strong sustained southerly and southeasterly winds raise the gulf level in the vicinity of the mouth of the Mississippi River by as much as 5 feet or more on some occasions and cause river stages to rise rapidly. Strong sustained northwesterly winds lower the gulf level as much as 2 feet and cause the river stages to fall rapidly.

2.1.8. The discharges and river stages used in this study are average monthly values based on a 10-year average using records and data recorded by the U. S. Army Corps of Engineers, New Orleans District. The bay or gulf stages used in the study are average monthly values based on a 5-year average using U. S. Army Corps of Engineers' records.

2.1.9. The average monthly discharges at Venice, Louisiana, and the average monthly river and gulf stages used to compute and compile the data for the existing Mississippi River hydraulic conditions are shown in Table 1. Tables 2-5 show the average monthly discharges in cubic feet per second into each of the four study units for the existing river conditions.

2.1.10. Discharge into the wetlands and marshes adjacent to the river within the four subunits of the project area was computed using stage and discharge data for the Mississippi River. The discharge into these areas results from three principal sources - minor distributaries, numerous existing outlets, and overbank flow. The quantity of flow

TABLE 1

EXISTING MISSISSIPPI RIVER CONDITIONS
MONTHLY AVERAGE DISCHARGES AND STAGES

| Month | Average Monthly Discharge at Venice (cfs)2/ | Average Monthly Stages in Feet NGVD1/ Mississippi River at: Venice mi 10.7 AHP3/ | Head of Passes | Joseph Bayou mi 4.5 BHP4/ | W-2 mi 9.8 BHP | Burrwood mi 14.5 BHP | Jetties mi 18.2 BHP |
|---|---|---|---|---|---|---|---|
| JAN | 335,000 | 1.78 | 1.63 | 1.38 | 1.18 | 1.01 | 0.60 |
| FEB | 525,000 | 2.03 | 1.69 | 1.56 | 1.41 | 1.16 | 0.70 |
| MAR | 725,000 | 3.32 | 2.71 | 2.46 | 2.18 | 1.89 | 1.50 |
| APR | 810,000 | 4.02 | 3.29 | 3.02 | 2.74 | 2.42 | 2.00 |
| MAY | 745,000 | 3.90 | 3.27 | 3.03 | 2.76 | 2.47 | 2.10 |
| JUN | 560,000 | 3.08 | 2.70 | 2.51 | 2.33 | 2.14 | 1.90 |
| JUL | 350,000 | 2.46 | 2.32 | 2.23 | 2.17 | 2.07 | 2.00 |
| AUG | 285,000 | 2.30 | 2.19 | 2.11 | 2.05 | 1.98 | 1.90 |
| SEP | 270,000 | 2.25 | 2.15 | 2.09 | 2.03 | 1.98 | 1.90 |
| OCT | 260,000 | 1.99 | 1.90 | 1.64 | 1.53 | 1.43 | 1.30 |
| NOV | 255,000 | 1.70 | 1.61 | 1.34 | 1.23 | 1.13 | 1.00 |
| DEC | 280,000 | 2.03 | 1.92 | 1.48 | 1.32 | 1.18 | 1.00 |

1/ NGVD - National Geodetic Vertical Datum
2/ cfs - Cubic feet per second
3/ AHP - Above Head of Passes
4/ BHP - Below Head of Passes

TABLE 2

EXISTING MISSISSIPPI RIVER CONDITIONS
AVERAGE MONTHLY DISCHARGES IN CUBIC FEET PER SECOND (CFS)
LEFT DESCENDING (EAST) BANK, VENICE TO HEAD OF PASSES

| Month | Baptiste Collette Bayou mi 11.5 AHP | Cubits Gap mi 3.0 AHP | Pass a Loutre Head of Passes | South Pass Head of Passes | Overbank | Existing Outlets | Total |
|---|---|---|---|---|---|---|---|
| JAN | 13,400 | 36,850 | 102,200 | 50,900 | 0 | 7,000 | 210,000 |
| FEB | 21,000 | 57,750 | 162,800 | 81,400 | 0 | 7,400 | 330,000 |
| MAR | 29,000 | 67,400 | 213,200 | 105,900 | 0 | 14,500 | 430,000 |
| APR | 32,400 | 72,900 | 223,600 | 111,800 | 0 | 16,200 | 457,000 |
| MAY | 29,800 | 67,100 | 204,100 | 101,300 | 0 | 17,900 | 420,000 |
| JUN | 22,400 | 53,200 | 162,400 | 80,600 | 0 | 12,300 | 331,000 |
| JUL | 14,000 | 33,300 | 106,100 | 53,200 | 0 | 6,300 | 213,000 |
| AUG | 11,400 | 31,400 | 85,500 | 42,800 | 0 | 5,700 | 177,000 |
| SEP | 10,800 | 29,700 | 81,500 | 41,000 | 0 | 5,100 | 168,000 |
| OCT | 10,400 | 28,600 | 78,800 | 39,300 | 0 | 6,200 | 163,000 |
| NOV | 10,200 | 28,100 | 77,500 | 38,800 | 0 | 5,600 | 160,000 |
| DEC | 11,200 | 30,800 | 84,000 | 42,000 | 0 | 7,800 | 176,000 |

TABLE 3

EXISTING MISSISSIPPI RIVER CONDITIONS
AVERAGE MONTHLY DISCHARGE IN CUBIC FEET PER SECOND (CFS)
RIGHT DESCENDING (WEST) BANK, VENICE TO HEAD OF PASSES

| Month | Grand Pass mi 10.5 AHP | Overbank | Existing Outlets | Total |
|---|---|---|---|---|
| JAN | 16,800 | 0 | 5,800 | 23,000 |
| FEB | 26,200 | 0 | 6,000 | 32,000 |
| MAR | 36,200 | 35,000 | 10,800 | 82,000 |
| APR | 40,500 | 75,400 | 13,800 | 130,000 |
| MAY | 37,200 | 70,400 | 12,900 | 121,000 |
| JUN | 28,000 | 29,500 | 9,000 | 67,000 |
| JUL | 17,500 | 8,600 | 4,700 | 31,000 |
| AUG | 14,200 | 4,200 | 4,200 | 23,000 |
| SEP | 13,500 | 2,900 | 3,700 | 20,000 |
| OCT | 13,000 | 0 | 5,000 | 18,000 |
| NOV | 12,800 | 0 | 4,600 | 17,000 |
| DEC | 14,000 | 0 | 6,300 | 20,000 |

TABLE 4

EXISTING MISSISSIPPI RIVER CONDITIONS
AVERAGE MONTHLY DISCHARGE IN CUBIC FEET PER SECOND (CFS)
LEFT DESCENDING (EAST) BANK OF SOUTHWEST PASS

| Month | Overbank | Existing Outlets | Total |
|---|---|---|---|
| JAN | 0 | 17,800 | 18,000 |
| FEB | 0 | 24,100 | 24,000 |
| MAR | 1,800 | 37,900 | 40,000 |
| APR | 7,800 | 47,300 | 55,000 |
| MAY | 8,200 | 44,700 | 53,000 |
| JUN | 2,500 | 32,000 | 35,000 |
| JUL | 800 | 17,300 | 18,000 |
| AUG | 200 | 15,100 | 15,000 |
| SEP | 100 | 13,200 | 13,000 |
| OCT | 0 | 14,500 | 15,000 |
| NOV | 0 | 13,500 | 14,000 |
| DEC | 0 | 17,300 | 17,000 |

TABLE 5

EXISTING MISSISSIPPI RIVER CONDITIONS
AVERAGE MONTHLY DISCHARGE IN CUBIC FEET PER SECOND (CFS)
RIGHT DESCENDING (WEST) BANK OF SOUTHWEST PASS

| Month | Overbank | Existing Outlets | Total |
|---|---|---|---|
| JAN | 0 | 13,800 | 14,000 |
| FEB | 0 | 20,200 | 20,000 |
| MAR | 0 | 29,500 | 30,000 |
| APR | 1,500 | 34,500 | 36,000 |
| MAY | 1,800 | 32,000 | 34,000 |
| JUN | 300 | 23,600 | 24,000 |
| JUL | 100 | 13,900 | 14,000 |
| AUG | 0 | 11,700 | 12,000 |
| SEP | 0 | 10,900 | 11,000 |
| OCT | 0 | 11,100 | 11,000 |
| NOV | 0 | 10,700 | 11,000 |
| DEC | 0 | 12,600 | 13,000 |

which occurs from each of these sources was computed using available data. The quantity of discharge through the distributaries such as Baptiste Collette Bayou, Grand Pass, and Cubits Gap was determined by using a percent of the total Mississippi River flow reaching the vicinity of Venice, Louisiana. These percentages were developed by the U. S. Army Corps of Engineers and are based on measurements of the quantity of discharge which has occurred at these outlets. The quantity of discharge through the existing outlets was computed using the principle of flow over a submerged weir. The volume of flow over a submerged weir is a function of width of the outlet, the elevation of the crest of the submerged weir or bottom of the outlet, and the river stage and the bay or gulf stage. The quantity of discharge over the banks was computed using the principle of flow over a broad-crested weir. The volume of flow over a broad-crested weir is a function of the width of the low area of overbank and the depth of the flow over the crest.

Equation for Discharge over a Submerged Weir:

$$Q = 3.33\ L\ H_1^{1/2}\ (H_1 + 1.5H_2)$$

where

Q = maximum discharge in cubic feet per second (cfs)

L = unobstructed length of the weir (feet)

$H_1$ = upstream water surface elevation minus downstream water surface elevation in feet (river stage minus gulf or bay stage)

$H_2$ = downstream water surface elevation minus weir crest elevation in feet. (gulf or bay stage minus weir crest elevation)

Source: USACE, New Orleans District.

Equation for Discharge over a Broad-Crested Weir:

$$Q = 3.087\ L\ (H)^{3/2}$$

where

Q = maximum discharge in cubic feet per second (cfs)

L = unobstructed length of the weir (feet)

H = head on the crest in feet (upstream water surface elevation minus weir crest elevation)

Source: Davis (1942).

2.1.11. The Mississippi River discharge reaching the vicinity of Venice, Louisiana, is presently distributed to the Gulf of Mexico through a combination of routes including the major passes, minor distributaries, numerous existing outlets, and overbank flow (see Plate 1). Considering the average flow distribution shown in Table 6, the three major passes of the Mississippi River - Southwest Pass, Pass a Loutre, and South Pass - all of which originate at the Head of Passes - presently discharge 74.2 percent of the river's flow at Venice. Southwest Pass and Pass a Loutre each discharge an average 29.7 percent of the flow while South Pass discharges 14.8 percent (Table 6). The distributaries - Baptiste Collette Bayou at river mile 11.5 AHP, Grand Pass at river mile 10.5 AHP, and Cubits Gap at river mile 3 AHP - discharge on the average a total of 19.3 percent of the flow reaching the vicinity of Venice, Louisiana. Baptiste Collette Bayou presently discharges approximately 4.0 percent of the flow into the marshes and wetlands located on the left descending (east) bank. Grand Pass discharges approximately 5.0 percent of the flow into the adjacent wetlands on the right descending (west) side of the river. A portion of this discharge is distributed to the gulf via Tiger Pass and Pass Tante Phine. An average 10.3 percent of the river's flow is discharged into the wetlands on the left descending (east) side of the river through Cubits Gap. All flow through this outlet is further distributed through Main Pass, Octave Pass, Brant Bayou, and Raphael Pass.

TABLE 6

EXISTING AND PROJECT CONDITIONS PREDICTED FOR THE MISSISSIPPI RIVER FLOW DISTRIBUTION, VENICE TO THE GULF, IN TERMS OF PERCENT OF RIVER FLOW AT VENICE

| Source | | Month | | | | | | | | | | | | AVG FLOW DIST |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | |
| **Baptiste Collette** | Existing | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| | Project | 4.0 | 4.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.4 |
| **Grand/Tiger Pass** | Existing | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| | Project | 5.0 | 5.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.4 |
| **Cubits Gap** | Existing | 11.0 | 11.0 | 9.3 | 9.0 | 9.0 | 9.5 | 9.5 | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | 10.3 |
| | Project | 11.0 | 11.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 | 11.4 |
| **Southwest Pass** | Existing | 30.5 | 31.0 | 29.4 | 27.6 | 27.4 | 29.0 | 30.3 | 30.0 | 30.2 | 30.3 | 30.4 | 30.0 | 29.7 |
| | Project | 30.9 | 31.2 | 29.2 | 29.4 | 28.8 | 29.2 | 29.4 | 30.8 | 30.8 | 30.6 | 30.8 | 30.4 | 30.2 |
| **South Pass** | Existing | 15.2 | 15.5 | 14.6 | 13.8 | 13.6 | 14.4 | 15.2 | 15.0 | 15.2 | 15.1 | 15.2 | 15.0 | 14.8 |
| | Project | 15.4 | 15.6 | 14.5 | 14.7 | 14.5 | 14.7 | 14.8 | 15.3 | 15.3 | 15.3 | 15.3 | 15.2 | 15.1 |
| **Pass a Loutre** | Existing | 30.5 | 31.0 | 29.4 | 27.6 | 27.4 | 29.0 | 30.3 | 30.0 | 30.2 | 30.3 | 30.4 | 30.0 | 29.7 |
| | Project | 30.9 | 31.2 | 29.2 | 29.4 | 28.8 | 29.2 | 29.4 | 30.8 | 30.8 | 30.6 | 30.8 | 30.4 | 30.2 |
| **East Bank (AHP) Overbank & Outlet Flows** | Existing | 2.1 | 1.4 | 2.0 | 2.0 | 2.4 | 2.2 | 1.8 | 2.0 | 1.9 | 2.4 | 2.2 | 2.8 | 2.1 |
| | Project | 2.0 | 1.4 | 2.9 | 2.0 | 3.4 | 2.8 | 2.4 | 2.2 | 2.2 | 2.5 | 2.2 | 2.8 | 2.4 |
| **West Bank (AHP) Overbank & Outlet Flows** | Existing | 1.7 | 1.1 | 6.3 | 11.0 | 11.2 | 6.9 | 3.9 | 3.0 | 2.5 | 1.9 | 1.8 | 2.2 | 4.5 |
| | Project | 0.8 | 0.6 | 1.2 | 1.5 | 1.5 | 1.1 | 1.0 | 0.9 | 0.9 | 1.0 | 0.9 | 1.2 | 1.0 |

2.1.12. Under existing conditions, an average of 2.1 percent of the river's flow reaching the vicinity of Venice, Louisiana, is distributed into the wetlands along the left descending (east) bank in the reach between Venice and Head of Passes through existing outlets located at river miles 4.9 and 6.45 AHP.

2.1.13. An average 4.5 percent of the river's flow reaching the vicinity of Venice, Lousiana, is discharged into the marshes and wetlands along the right descending (west) bank of the river through existing minor outlets and overbank flows. Overbank flows presently occur at high-river stages over a length of approximately 14,200 feet of low overbanks between river mile 1.2 and 4.0 AHP. Discharge also occurs along the right descending bank between Venice and Head of Passes through existing outlets located at river miles 5.8, 6.9, and 7.0 AHP (see Plate 1).

2.1.14. A portion of the river's flow in Southwest Pass is discharged into the marshes and wetlands adjacent to the pass through existing outlets and at high stages via the overbanks. Discharge occurs into the left descending (east) bank of Southwest Pass through existing outlets located at river miles 3.1, 3.4, 3.8, 4.5, and 14.5 Below Head of Passes (BHP). On the right descending (west) bank of the pass, discharges occur through existing outlets located at river miles 2.1, 3.0, and 9.8 BHP. During periods of high-river stages, discharge into the wetlands also occurs by overtopping of the relatively low banks along Southwest Pass. Along the east or left descending bank, these low areas are located at river miles 4.8, 5.7, and 9.0 BHP and on the west or right descending bank; the low banks are located at river miles 13.3, 14.0, 16.4, and 17.7 BHP (Plate 1).

## 2.2. Existing Circulation Patterns

### 2.2.1. West Delta

2.2.1.1. Plate 2 shows generalized surface circulation patterns in the shelf waters surrounding the Mississippi River delta developed from Wright and Coleman (1974), Murray (1976), and Rouse and Coleman (1976). The mouths of South Pass and Southwest Pass are deep and narrow and are located near the edge of the continental shelf (Wright and Coleman, 1974). Most of the sediment-bearing waters of the Mississippi River are now discharged directly into the Gulf of Mexico through these two passes in a rapid, jetlike manner attributable to the leveeing and channelizing of the river over the past 100 years (Wells et al., 1981; Gallaway, 1981). The river discharge emanates from the passes as a highly turbid, distinct surface plume which is easily tracked on satellite imagery (Rouse and Coleman, 1976; Wiseman et al., 1976; Gallaway, 1981). Because of the significant density differences between this freshwater plume and the clear, saline, mid-depth water in the open gulf, eddy diffusivity is limited and Mississippi River water is identifiable as far away as the South Texas coast (Wiseman, et al., 1976; Gallaway, 1981; Wells et al., 1981). The fact that this low-salinity river water remains confined to the Texas-Louisiana shelf is an indication of the long-term westerly drift of the water surface along the Louisiana coast (Wells et al., 1981).

2.2.1.2. The controlling mechanisms for regional circulation in Louisiana's coastal waters include wind, waves, tide, freshwater input, pressure gradients, semi-permanent water slopes, and large-scale gulf circulation. Winds are relatively constant in an east-west direction. The winds are from the eastern quadrant approximately 70 percent of the year. During summer, winds are southeasterly, shifting to northeasterly in autumn. Winter winds are stronger and more variable as a result of the passage of numerous frontal systems. With the arrival of spring,

winds shift back to the southeast. Westerly winds are rarely observed at any time of the year, and, as a result, most of the wind-driven surface water movement is to the west (Wells et al., 1981).

2.2.1.3. In addition to prevailing easterly winds, surface effluents from South Pass and Southwest Pass move generally westward because these discharge directly into the slow-moving, thin (vertical thickness 1 meter or less) and highly-stratified (underlain by saltwater) band of fresh to slightly brackish (less than 12 °/oo salinity) turbid water which hugs the southeastern delta and is pushed generally westward by persistent southwesterly setting coastal currents (Murray, 1976; Plate 2). These low-salinity waters are the result of freshwater discharge from the numerous outlets northeast of South Pass (Wright and Coleman, 1974). Under normal conditions, one or more intermediate water masses consisting of slightly diluted gulf water (25-30 °/oo salinity) separate the ambient coastal freshwater band from gulf water (Wright and Coleman, 1974).

2.2.1.4. LANDSAT images of the delta taken only a day or so apart indicate that the size, shape, and direction of the Mississippi River plumes can vary within a short time span as a result of river stages, wind speed and direction, and tidal influence (Rouse and Coleman, 1976). However, the dominant surface circulation pattern in the Mississippi Bight (coastal indentation immediately west of the delta) is in the form of a clockwise gyre (Wells et al., 1981). The plume from Southwest Pass jets out into the gulf in a southwesterly direction, then curves northwestward back toward the coast (Plate 2). As it curves toward shore, it appears to split into two parts, one flowing westward along the coast and one returning eastward toward the delta in a large-scale, clockwise eddy. Water flowing out of South Pass moves generally southwestward along the shelf and towards the coastline, but some flow does occur towards the east during high river stages (Gallaway, 1981;

Wiseman et al., 1976; Dr. W. Wiseman, 1983, Coastal Studies Institute, LSU, Baton Rouge, pers. comm.).

2.2.1.5. In addition to the main Mississippi River channels, freshwater also enters the entire coastal region through smaller rivers and bayous, brackish bays, and estuaries. The abundant rainfall in South Louisiana (greater than 59 in/yr) is transported through these numerous tributaries into the gulf (Wells et al., 1981). Mississippi River water also can escape into the interdistributary bays by way of numerous crevasses which dissect the interdistributary levees when river water is impounded during flooding tides, onshore winds, or higher river stages. These crevasses are oriented perpendicular to the main distributaries and occur where topographic dips in the natural levee allow local levee overtopping under high-water conditions (Wright and Coleman, 1974). All of this freshwater entering the Mississippi Bight results in a stratified water column in which a two-layered flow is possible (Wells et al., 1981). The lightly mixed upper layers of water respond quickly to shifts in wind direction (Wells et al., 1981), and nearshore currents just west of the delta can move south, west, or east under different wind and tide conditions (Gallaway, 1981). Winds blowing on the surface waters in a stratified water column in shallow water (30m or less) would drive the surface layer (above 6m) in the direction of the wind while flow in the lower layer is in the opposite direction to satisfy continuity (Murray, 1976; Wells et al., 1981). During intervals of low wind speeds, the entire water column is strongly influenced by the temporal changes of the tidal currents. The well-organized tidal current field near shore rotates in a clockwise direction (northeasterly to easterly) at flood tide and reverses itself at ebb tide. Tidal currents seaward of about the 25m contour move in the opposite direction as the nearshore currents at both flood and ebbtides. The strongest tidal currents occur near Southwest Pass where severe bottom curvature has produced a complex pattern of cotide lines (Murray, 1976).

2.2.1.6. Very little is known about currents inside the 10-m contour along the Louisiana coast (Murray, 1976). Wave energy along the northern Gulf of Mexico is low as a result of limited fetch, but it is nevertheless responsible for some of the longshore circulation in the nearshore zone. Waves from the southeast driven by southeast winds induce a longshore transport to the west. However, littoral currents may respond more directly to winds and tides than to waves, and much of the coastal water and sediment movement is driven by tidal exchange through estuary passes (Wells et al., 1981).

2.2.2. East Delta

2.2.2.1. The mouths of Pass a Loutre, Main Pass, and numerous small distributaries to the east of South Pass are wide and shallow and discharge into shallow water (Wright and Coleman, 1974; Dr. John T. Wells, Coastal Studies Institute, Louisiana State University, Baton Rouge, pers. comm.). Some of this water is entrained by the southwesterly moving coastal boundary layer of low-salinity water, but some is pushed east and north by winds and tides (Rouse and Coleman, 1976; Stone and Robbins, 1973; Plate 2). The plume from South Pass might even occasionally be pushed northeastward under the influence of southwesterly winds (Rouse and Coleman, 1976). This plume often splits into two or three components depending on the winds - one part flowing eastward, a portion moving south into the deep gulf, and the major portion flowing westward into and with the coastal boundary layer and combining with the plume flowing southwestward from Southwest Pass. Some of this westward-flowing South Pass plume is pushed into East Bay by southerly or southeasterly winds and influences circulation there.

## 2.3. Existing Salinity Distributions

2.3.1. Salinity variation within the Mississippi delta marshes depends on location, water depth, river discharge levels, and circulation pat-

terns. Areas which receive no overbank or outlet flow during non-flood periods when river discharge is low tend to experience a greater degree of saltwater intrusion. However, shallow water depths limit salinity penetration. Freshwater discharge from the Mississippi River into the marsh is the most important factor in determining the salinity regime. Other factors such as high winds, extreme tides, or storms may cause local, short-lived variations in the marsh salinity regime (USACE, 1983).

2.3.2. Three base surface salinity maps (Plates 3, 4, and 5) summarize salinity data for average low, medium, and high river discharges under existing conditions. Isohalines shown on the plates enclose the general areas, for each discharge, which have the stated salinity or less. During low river discharges (10-year average = 260,000 cfs), salinity in the marshes fringing the east and west deltas and along the lower reaches of Southwest Pass and South Pass can reach as high as 28 °/oo (Gallaway, 1981; USACE, 1983). This level diminishes to less than 15 °/oo within a short distance inland (Plate 3). At medium river discharges (10-year average = 350,000 cfs), most of the delta marsh waters are probably fresh (salinity less than 2 °/oo). The fringing marshes and those along South Pass and Southwest Pass might experience salinities as high as 10-15 °/oo where there is little or no overbank or outlet flow (Plate 4). During high-flow periods (10-year average = 810,000 cfs), all overbank waters are fresh (salinity less than 1 °/oo), and the 1 °/oo isohaline lies several miles offshore all around the delta (Plate 5; Wiseman et al., 1976; USACE, 1983).

2.3.3. Surface salinity distributions in the gulf waters east of the delta have not been detailed, but those in the Mississippi Bight west of the delta are strongly influenced by the fresh and brackish waters from the Mississippi River and the larger bays such as Barataria to the north (Murray and Wiseman, 1976). Little vertical mixing with ambient gulf and coastal waters occurs in the Mississippi Bight resulting in a

stratified water column with a two-layered flow (Wells et al., 1981). Surface circulation of brackish water in the Mississippi Bight in the form of a clockwise gyre has been described previously, but this relatively warm surface layer is underlain by colder, heavier, saltier water which enters the Mississippi Bight by creeping up a deep channel in the continental slope and mixing with other shelf waters. The flow in this lower layer is generally northerly and northeasterly toward the coast (Murray and Wiseman, 1976). During periods of low river discharge, this saline gulf water might be upwelled and advected inshore along the bottom of the shelf (Gallaway, 1981), thus contributing to highly stratified nearshore waters and saltwater intrusion into the marshes.

## 2.4. Existing Dissolved Oxygen Concentrations

2.4.1. The principal source of oxygen in the Mississippi River is reaeration of the water from atmospheric oxygen. Dissolved oxygen (DO) concentrations in the river water (5 stations between St. Francisville and Venice) are usually near saturation (100 percent saturation = 12.8 mg/l $O_2$ at 5°C and 7.6 mg/l $O_2$ at 30°C). The dissolved oxygen saturation levels of Mississippi River water exceed 75 percent saturation 90 percent of the time. The saturation values indicate that the river is well-aerated, capable of assimilating oxygen-consuming wastes, and able to support aquatic organisms. Because the solubility of oxygen in water is inversely related to temperature, the highest DO concentrations are usually found during the winter months, and the lowest during the summer months (Wells, 1980). Although DO concentrations have been less than 5 mg/l at New Orleans (Louisiana Stream Control Commission, 1977) on some occasions, they are generally of short duration, and average daily concentrations are generally greater than 5 mg/l (Wells, 1980).

2.4.2. DO levels in shelf waters of the Mississippi Bight, on the other hand, are often at 50 percent saturation over large areas, particularly

in summer (Turner and Allen, 1983). These levels vary considerably with seasonal trends in temperature, mixing, salinity, organic carbon load, respiration, and photosynthesis. High DO levels are promoted by low temperature, wave turbulence, and high rate of photosynthesis. DO levels are generally higher in surface than in bottom waters (Gallaway, 1981).

2.4.3. The occurrence of hypoxic (less than or equal to 2 mg/l $0_2$) bottom waters has been noted for that area of the shelf lying between the delta and Grand Isle. Such conditions are pronounced during spring and summer months and have been associated with: (1) high loadings of organic materials from the previous spring flooding of the Mississippi and Atchafalaya Rivers; (2) the resulting isolation of near-bottom waters having a high oxygen demand from a surface layer of freshwater during periods when temperatures are high and waves and other sources of energy are insufficient to mix the two water masses; and (3) the long residence time of water in the area because of the eddy current. The extent of the area affected by hypoxia and the duration of the event appears to be related to flooding (more flooding = more hypoxia; Gallaway, 1981).

2.4.4. By inference, in the nearshore waters and marshes of the west delta, river influence with its cooler temperatures and higher DO levels helps keep DO concentrations adequate (at least 5 mg/l $0_2$) most of the time. During occasional very low-flow periods in summer when warmer, lower DO gulf waters intrude into the shallow, low-wave energy littoral zones of the delta, nearshore and inshore DO levels might be reduced briefly. The DO data of the U.S. Army Corps of Engineers (1983), New Orleans District, for the 1973 to 1982 period indicate that DO concentrations in the delta marshes usually range between 5.0 mg/l and 12.0 mg/l which are sufficient to sustain all forms of aquatic life.

## 2.5. Existing Dissolved Nutrient Levels

2.5.1. The distribution of nutrients in Louisiana's coastal and estuarine waters depends on the volume of Mississippi River water discharged, coastal current and wind direction, rainfall, and the proximity of these waters to the marshes and agricultural lands (Ho and Barrett, 1975). The nutrient levels in the project area marshes would be affected by the distributary flow, outlets and overbank flow, suspended sediment deposition, and decomposition of the marsh vegetation and biological population. The distribution of nitrogen and phosphorus, the two essential nutrients important in coastal area productivity in the project area, are discussed here. The data available in the literature on these two nutrients are dissolved nitrogen and phosphorus levels in the surface waters of river, overbank, estuaries, and nearshore gulf (Ho and Barrett, 1975; USGS, 1979, 1980, 1981; USACE, 1981a). The existing levels of these nutrients are described in the following paragraphs.

### 2.5.2. Dissolved Nitrogen

2.5.2.1. Data presented in Table 7 and Plate 6 indicate that total dissolved nitrogen (ammonium + nitrite/nitrate + organic nitrogen) present in the Mississippi River water at high-flow periods was consistently slightly greater than at low-flow conditions. Dissolved nitrogen concentrations in the river-water discharge at the mouth of Southwest Pass and that at the mouth of South Pass were similar under both low-flow and high-flow conditions (Table 2).

2.5.2.2. Total dissolved nitrogen levels in the Venice to the gulf overbank water samples taken at high-flow periods ranged from 1.42 to 1.95 mg/l nitrogen (Plate 6).

TABLE 7

DISSOLVED NUTRIENT LEVELS IN THE LOWER MISSISSIPPI RIVER

**Mouth of Southwest Pass**

| | Total Nitrogen [1/] | Total Phosphorus [2/] |
|---|---|---|
| High Flow | 2.25 mg/1 [1/] | 0.16 mg/1 |
| Low Flow | 1.71 mg/1 | 0.21 mg/1 |

**Mouth of South Pass**

| | Total Nitrogen | Total Phosphorus |
|---|---|---|
| High Flow | 2.16 mg/1 | 0.18 mg/1 |
| Low Flow | 1.89 mg/1 | 0.20 mg/1 |

1/ Total Nitrogen = ammonium + nitrate/nitrite + organic nitrogen
2/ Total Phosphorus = inorganic + organic phosphorus.

Source of data: USGS (1979; 1980; 1981).

2.5.2.3. Total nitrogen levels in the nearshore gulf waters west of Southwest Pass were variable and were influenced by the proximity to the coastal marshes and flow conditions (Plate 6). For example, total dissolved nitrogen concentrations in the water samples collected from stations close to the shoreline were much higher than in the samples collected from stations farther gulfward. The nearshore dissolved nitrogen levels show an impact of runoff from the marshes and possibly agricultural lands containing high concentrations of total nitrogen. Total dissolved nitrogen concentrations in the nearshore waters at low-flow periods were low (range of 0.16 to 0.46 mg/l nitrogen), typical of gulf waters not influenced by coastal runoff and river flow (Plate 6).

2.5.2.4. The Mississippi River water generally contains high levels of nitrate/nitrite nitrogen and organic nitrogen and low levels of ammonium nitrogen (Ho and Barrett, 1975). In delta coastal waters, nitrate/nitrite values generally are higher at the surface than at the bottom, and are highest in the late winter and spring and lowest during summer and fall because river water is a source of this nutrient [highest values occur during months of peak river discharge (Barrett et al., 1978)]. Ammonium nitrogen concentrations are higher in summer and fall and lower in late winter and spring. Organic nitrogen originates from both the river and marshes, but also can show some increase in spring in the bays because of phytoplankton production.

2.5.2.5. Nitrate/nitrite nitrogen concentrations are related inversely to ammonium nitrogen concentrations (Sklar and Turner, 1981) and salinity (Ho and Barrett, 1975). Changes in the nitrate/nitrite nitrogen and salinity levels, therefore, would be good indicators for defining zones of Mississippi River water and gulf water influence.

2.5.3. Dissolved Phosphorus

2.5.3.1. Total dissolved phosphorus (inorganic + organic phosphorus) data for the Mississippi River water, the river overbank water, Venice to the gulf, and nearshore gulf water south and west of Southwest Pass are presented in Plate 7. Total phosphorus levels in the Mississippi River waters during high-flow and low-flow periods are similar and range from 0.16 to 0.21 mg/l (Table 7). The levels in the overbank areas ranged from 0.16 to 0.33 mg/l phosphorus and did not indicate consistent trends with regard to sampling locations and flow conditions (Plate 7). Total phosphorus concentrations in the nearshore waters decreased gulfward and indicated diminishing influence of the river input (Plate 7).

2.5.3.2. The ratio of inorganic to organic phosphorus in the river, overbank, and nearshore water did not indicate any consistent trend (Ho and Barrett, 1975; USGS, 1979, 1980, 1981; USACE, 1981).

## 2.6. Existing Pollutant Levels

2.6.1. Recent studies by the New Orleans District (USACE, 1982) as well as historical data for the lower Mississippi River were summarized to evaluate the ambient quality of native water and bed sediments within the project reach. Though not inclusive of all possible data, a sufficient data base was compiled to present a significant representation of the ambient contaminant levels. The average number of individual data points comprising the mean water and sediment values for each constituent was 83 and 95, respectively. These data covered a period of approximately 8 years, 1975 through 1982.

2.6.2. Numerous parameters have been analyzed in varying degrees over the period represented by the data sources utilized in this investigation. Included in these parameters are conventional constituents,

trace metals, insecticides, herbicides, and base-neutral organics. Some of these parameters are analyzed frequently by the governmental agencies responsible for much of the available water quality and sediment data from the region (U. S. Geological Survey and U. S. Army Corps of Engineers), while other constituents are represented by only a small number of samples taken during non-routine investigations. The constituents included in the following discussion represent only those which were shown to have a sufficient number of samples to calculate a representative average for the project area. Additionally, only those contaminants which were known to be constituents of significant long-term ecological concern as a toxic or hazardous substance, and which were consistently found in either the water or sediments, were included.

2.6.3. The contaminants considered to be of ecological concern, and used in describing the existing water and sediment quality of the river below Venice include:

| | |
|---|---|
| Arsenic | Chlordane |
| Cadmium | DDD |
| Chromium | DDE |
| Copper | DDT |
| Lead | Dieldrin |
| Nickel | PCB (total) |
| Mercury | Phthlate Esters |
| Zinc | |

2.6.4. Ambient Water Quality

2.6.4.1. Table 8 presents the average ambient concentration of the contaminants meeting the above data requirements and found in Mississippi River water below Venice, Louisiana. The data used in calculating the average concentrations represent six primary data sources, as detailed in the table.

TABLE 8

AVERAGE AMBIENT WATER QUALITY[1/]
MISSISSIPPI RIVER, VENICE TO THE GULF

NATIVE WATER

| Constituent | Average Concentration ug/l | No. of Detectable[2/] Samples | No. of Samples Reported Below Detectable Limits[3/] | Total No. of Samples | Range ug/l |
|---|---|---|---|---|---|
| Arsenic | 2.2 | 77 | 0 | 77 | 0-4.0 |
| Cadmium | 0.5 | 77 | 0 | 77 | 0.1-10 |
| Chromium | 7.0 | 79 | 0 | 79 | 0-100 |
| Copper | 6.3 | 49 | 0 | 49 | 5-10 |
| Lead | 4.6 | 77 | 0 | 77 | 0-21 |
| Mercury | 0.15 | 156 | 2 | 158 | 0-4.5 |
| Nickel | 8.8 | 61 | 2 | 63 | 0-22 |
| Zinc | 34.4 | 74 | 2 | 76 | 9-120 |
| DDD | 0.005 | 89 | 3 | 92 | 0-.02 |
| DDT | 0.002 | 87 | 5 | 92 | 0-.01 |
| Dieldrin | 0.002 | 87 | 5 | 92 | 0-.01 |

Notes:

1/ The data utilized in preparing the constituent averages do not necessarily represent all data sources. Data is representative of only six primary reference sources.

a) USACE (1981b).

b) USACE (1981c).

c) USACE (1982).

d) USGS (1977).

e) USGS (1975-1977).

f) USGS (1980).

2/ Actual number of samples utilized to derive average constituent concentration.

3/ Number of samples where concentration was not quantified but reported below detection limits of analytical procedure. In data sources used, not all minimum detection limits were the same for the respective constituents.

2.6.4.2. The data suggest that there are 11 primary contaminants which are consistently detected in the water of the lower Mississippi River. Of these 11 contaminants, five are recorded at average concentrations above the EPA suggested chronic criteria for freshwater aquatic life (U. S. EPA, 1980). All average concentrations are well below acute criteria, however. Table 9 details the specific contaminant values (average concentration) along with the appropriate criteria.

2.6.4.3 Based on the above conditions, it is apparent that the ambient water quality in the project reach is influenced by upstream pollutants. In considering potential water quality impacts from the construction of the project features, especially when impacts are based on results of elutriate tests, the ambient conditions of the river water must be considered.

TABLE 9

AMBIENT WATER CONTAMINANTS IN EXCESS OF EPA FRESHWATER CRITERIA

| Average Contaminant ug/1 | EPA Chronic Concentration ug/1 | Degree of Criteria | Exceedance |
|---|---|---|---|
| Cadmium | 0.5 | 0.04 | 12.5x |
| Chromium | 7.0 | 0.29 | 24x |
| Copper | 6.3 | 5.6 | 1.12x |
| DDT | 0.002 | 0.001 | 2.0x |
| Dieldrin | 0.002 | 0.0019 | 1.05x |

## 2.6.5. Ambient Sediment Quality

2.6.5.1. Table 10 presents the average ambient concentration of selected contaminants meeting the data base requirements described in paragraph 2.6.2. above and found in detectable levels in bed sediments from the lower Mississippi River.

2.6.5.2. Fifteen primary contaminants consistently occurred in detectable concentrations in the bed sediments. Two additional substances, endrin and heptachlor, consistently appeared in the sediments as well; however, they were eliminated from Table 10 because of their overall low concentrations. The mean concentration for endrin in 20 samples was 0.2 ug/kg and the mean concentration for heptachlor in 13 samples was 0.018 ug/kg.

2.6.5.3. No standards or suggested criteria exist on which determinations of the relative quality of these sediments can be based.

2.6.5.4. Recent investigations by the New Orleans District have shown the long-term consistency of concentrations for trace metals and selected organics in the bed sediments. Figure 1 graphically portrays the average concentrations of the contaminants of concern over two time periods - 1975 through 1977, and 1982. Two conclusions are drawn from these data: (1) Concentrations of constituents in the bed sediments are rather consistent over time and do not exhibit drastic changes in concentrations; (2) A slight but consistent improvement in sediment quality is indicated in the 1982 results; however, because the 1982 data are based on only six samples, this trend is not well established.

## 2.7. <u>Existing Water Quality Problems</u>

2.7.1. The outstanding problem in the Mississippi River delta, as well as the entire Louisiana coastal region, is land loss. Rates of land

## TABLE 10

### AVERAGE AMBIENT SEDIMENT CHEMICAL QUALITY[1]
### MISSISSIPPI RIVER, VENICE TO THE GULF

| Contaminant | Average[2/] Concentration ug/l | No. of[3/] Detectable Samples | No. of Samples[4/] Reported Below Detectable Limits | Total No. of Samples | Ranges ug/l |
|---|---|---|---|---|---|
| Arsenic | 4,540 | 87 | 3 | 91 | 1000*-17,000 |
| Cadmium | 600 | 67 | 17 | 84 | 200*-2,100 |
| Chromium | 14,860 | 91 | 0 | 91 | 100-53,000 |
| Copper | 10,480 | 75 | 0 | 75 | 100-25,400 |
| Lead | 10,330 | 46 | 51 | 97 | unknown-70,000 |
| Mercury | 96 | 65 | 38 | 98 | 1.0*-1,200 |
| Nickel | 21,400 | 45 | 0 | 45 | 2,200-33,300 |
| Zinc | 47,620 | 91 | 0 | 91 | 7,000-122,000 |
| Chlordane | 4.46 | 58 | 51 | 109 | 0.01*-8.4 |
| DDE | 2.73 | 48 | 61 | 109 | 0.01*-8.4 |
| DDD | 4.41 | 80 | 27 | 107 | 0.1*-90 |
| DDT | 0.40 | 51 | 58 | 109 | 0.001*-12 |
| Dieldrin | 1.8 | 68 | 40 | 108 | 0.002*-20 |
| PCB (total) | 12.3 | 65 | 42 | 107 | 0.05*-210 |
| Phthalate Esters (total) | 338 | 5 | 13 | 18 | 100*-500 |

*Lowest detection limits in data

Notes:

1/ Data are representative of the following five primary reference sources.

a) USACE (1981b).

b) USACE (1981c).

c) USACE (1982).

d) USGS (1975-1977).

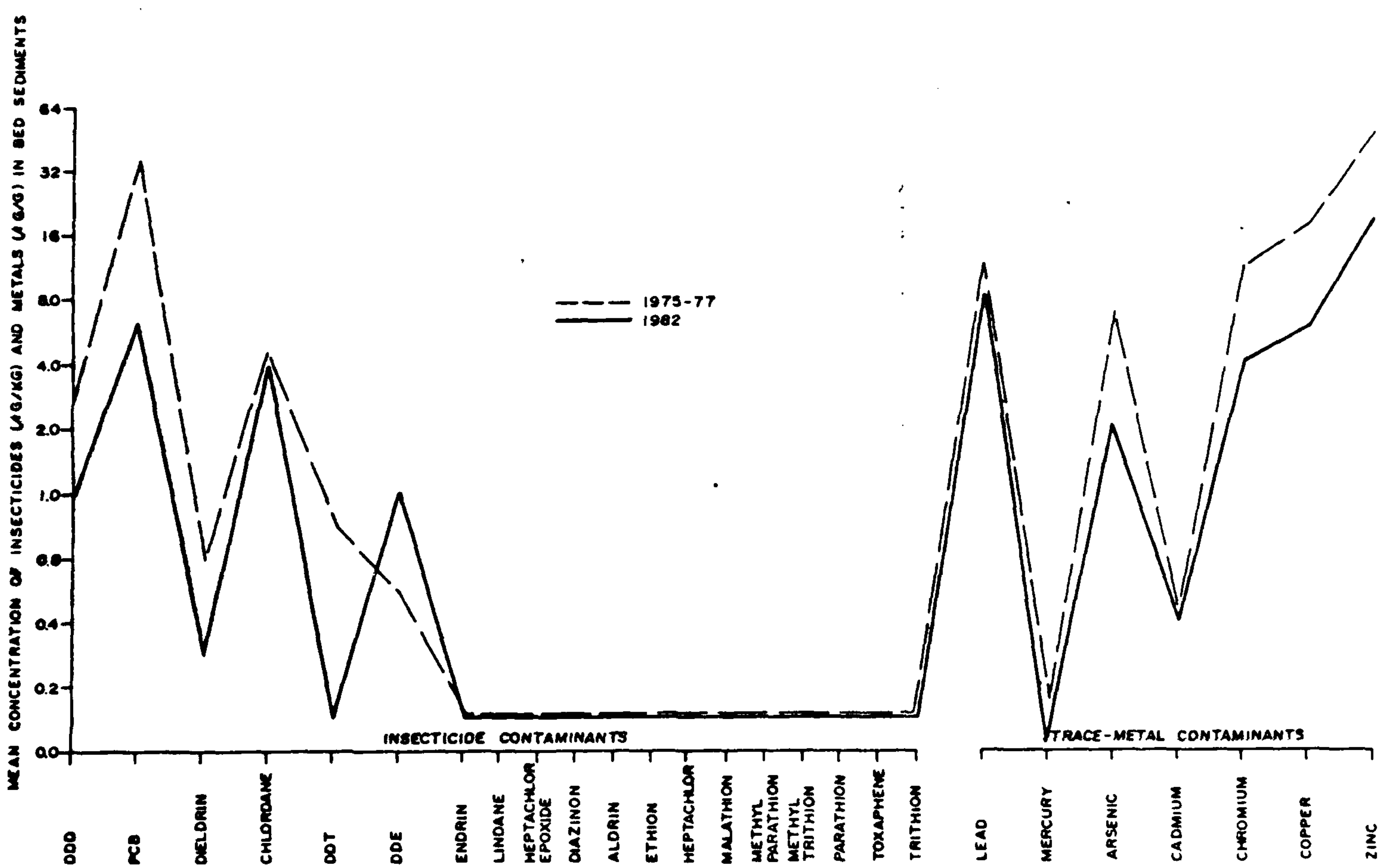
e) USGS (1982).

2/ The data used in computing the contaminant averages do not necessarily represent all data sources.

3/ Actual number of samples utilized to derive average contaminant concentration.

4/ Number of samples where concentration was not quantified but reported below detection limits of analytical procedure. In data sources used, not all minimum detection limits were the same for the respective contaminants.

FIGURE 1. "FINGERPRINTS" SHOWING MEAN CONCENTRATIONS OF SELECTED CONTAMINANTS IN MISSISSIPPI RIVER SEDIMENTS COLLECTED DURING TWO DIFFERENT TIME PERIODS.



loss up to 50 $mi^2$/yr have been reported for the coastal region (Day and Craig, 1981) and up to 32 $mi^2$/yr for the Mississippi River Deltaic Plain (Fruge, 1981). Because of the correlation between wetland acreages and fisheries production, this loss rate could result in as much as a one billion dollar loss to the commercial fishing industry alone over the next two decades (Turner, 1981). Part of this problem is linked to water quality because marshes are lost as a result of salinity changes as well as changing water depths. The dredging of canals, thought to be responsible for up to 90 percent of the wetland losses (Turner et al., 1981), and reduction in sediment supply because of levee construction, upstream impoundments, conservation practices, and channelization into deep gulf waters have led to the alteration of salinities and water depths. Both salinity changes and depth changes are occurring throughout the Mississippi River delta. These trends would continue relatively unchecked in the without project future.

## 3.0. PROJECT CONDITIONS

### 3.1. Project Flow Conditions

3.1.1. The post-project river stages calculated for several points between Venice and the Southwest Pass jetties are given in Table 11. A comparison of the existing and post-project river stages (Tables 1 and 11) indicates that the completion of training works generally would result in an increase in river stages and distributary flows (Table 6) between Venice and the Southwest Pass jetties. The relative increase in the elevation of river stages would be greater during high-flow periods (March through May) than during low- to medium-flow periods.

3.1.2. The river flow data given in Table 6 show that an average 0.4 percent more of the river flow at Venice would discharge through both the Baptiste Collette and Grand Pass distributaries after project completion. Cubits Gap would receive an additional 1.1 percent of the

TABLE 11

PROJECT CONDITIONS, MISSISSIPPI RIVER,
MONTHLY AVERAGE DISCHARGES AND STAGES

| Month | Average Monthly Discharge at Venice (cfs) 2/ | Average Monthly Stages in Feet NGVD 1/ Mississippi River at: Venice mi 10.7 AHP 3/ | Head of Passes | Joseph Bayou mi 4.5 BHP 4/ | W-2 mi 9.8 BHP | Burrwood mi 14.5 BHP | Jetties mi 18.2 HP |
|---|---|---|---|---|---|---|---|
| JAN | 335,000 | 1.78 | 1.63 | 1.38 | 1.24 | 1.14 | 0.60 |
| FEB | 525,000 | 2.03 | 1.69 | 1.65 | 1.61 | 1.34 | 0.70 |
| MAR | 725,000 | 4.00 | 3.39 | 3.00 | 2.59 | 2.12 | 1.50 |
| APR | 810,000 | 4.95 | 4.22 | 3.75 | 3.29 | 2.73 | 2.00 |
| MAY | 745,000 | 4.59 | 3.96 | 3.60 | 3.18 | 2.70 | 2.10 |
| JUN | 560,000 | 3.45 | 3.07 | 2.78 | 2.54 | 2.25 | 1.90 |
| JUL | 350,000 | 2.63 | 2.47 | 2.33 | 2.25 | 2.14 | 2.00 |
| AUG | 285,000 | 2.34 | 2.23 | 2.13 | 2.07 | 1.99 | 1.90 |
| SEP | 270,000 | 2.30 | 2.20 | 2.11 | 2.05 | 1.99 | 1.90 |
| OCT | 260,000 | 1.99 | 1.90 | 1.64* | 1.53* | 1.43* | 1.30 |
| NOV | 255,000 | 1.70 | 1.61 | 1.34* | 1.23* | 1.13* | 1.00 |
| DEC | 280,000 | 2.03 | 1.92 | 1.48* | 1.32* | 1.18* | 1.00 |

1/NGVD - National Geodetic Vertical Datum

2/cfs - Cubic feet per second

3/AHP - Above Head of Passes

4/BHP - Below Head of Passes

* Flows through these outlets during the indicated months were determined to result in no significant change to existing stages.

river flow after project completion. There would be a 0.5 percent increase in both the Southwest Pass and Pass a Loutre flows, and a 0.3 percent increase in the South Pass flow as a result of project completion.

3.1.3. Under existing conditions, an average of 4.5 percent of the river flow at Venice is discharged to the wetlands through overbank flows and minor outlets on the west bank between Venice and Head of Passes. The construction of spur dikes and bank nourishment to an elevation of +4.5 NGVD Above the Head of Passes would reduce this overbank river discharge to about 1.0 percent. As discussed later, an increase in the Grand Pass flow and the construction of four new outlets between Venice and Head of Passes (Plate 8) would compensate to some degree for the cutoff in the overbank flow.

3.1.4. The average monthly overbank, outlet, and distributary flow distributions calculated for the project conditions are given in Tables 12-15. The average monthly differences in the cfs between existing and project conditions and percent deviation as a result of project completion are given in Tables 16-19.

3.1.5. The locations of various distributaries and outlets under existing and project conditions are marked on Plates 1 and 8, respectively.

3.1.6. The existing and post-project total flows in cfs and percent change as a result of project completion relative to the existing flows for three flow conditions (low flow, November; high flow, April; and 12-month average flow) are given in Table 20 for each of the four study units. These data indicate the existing and project conditions compare as follows:

TABLE 12

PROJECT CONDITIONS, MISSISSIPPI RIVER,
AVERAGE MONTHLY DISCHARGE IN CFS, EAST BANK,
VENICE TO THE HEAD OF PASSES

| Month | Baptiste Collette Bayou mi 11.5 AHP | Cubits Gap mi 3.0 AHP | Pass a Loutre Head of Passes | South Pass Head of Passes | Overbank | Existing Outlets | Total |
|---|---|---|---|---|---|---|---|
| JAN | 13,400 | 36,900 | 103,500 | 51,600 | 0 | 6,700 | 212,000 |
| FEB | 21,000 | 57,800 | 163,800 | 81,900 | 0 | 7,400 | 332,000 |
| MAR | 36,200 | 87,000 | 211,700 | 105,100 | 0 | 21,000 | 461,000 |
| APR | 40,500 | 97,200 | 230,000 | 115,000 | 11,000 | 16,200 | 510,000 |
| MAY | 37,200 | 89,400 | 214,600 | 108,000 | 700 | 24,600 | 475,000 |
| JUN | 28,000 | 67,200 | 164,600 | 82,900 | 0 | 15,700 | 358,000 |
| JUL | 17,500 | 42,000 | 102,900 | 51,800 | 0 | 8,400 | 223,000 |
| AUG | 11,400 | 31,400 | 87,800 | 43,600 | 0 | 6,300 | 181,000 |
| SEP | 10,800 | 29,700 | 83,200 | 41,300 | 0 | 5,900 | 171,000 |
| OCT | 10,400 | 28,600 | 79,600 | 39,800 | 0 | 6,500 | 165,000 |
| NOV | 10,200 | 28,100 | 78,600 | 39,000 | 0 | 5,600 | 162,000 |
| DEC | 11,200 | 30,800 | 85,100 | 42,800 | 0 | 7,800 | 178,000 |

TABLE 13

PROJECT CONDITIONS, MISSISSIPPI RIVER,
AVERAGE MONTHLY DISCHARGE IN CFS, WEST BANK,
VENICE TO THE HEAD OF PASSES

| Month | Grand Pass | Over Bank | Outlets (Existing) | Outlets (Proposed) | Total |
|---|---|---|---|---|---|
| JAN | 16,800 | 0 | 0 | 2,700 | 20,000 |
| FEB | 26,200 | 0 | 0 | 3,200 | 29,000 |
| MAR | 43,500 | 0 | 0 | 8,700 | 52,000 |
| APR | 48,600 | 11,000 | 0 | 12,200 | 72,000 |
| MAY | 44,700 | 700 | 0 | 10,300 | 56,000 |
| JUN | 33,600 | 0 | 0 | 6,200 | 40,000 |
| JUL | 21,000 | 0 | 0 | 3,500 | 25,000 |
| AUG | 14,200 | 0 | 0 | 2,600 | 17,000 |
| SEP | 13,500 | 0 | 0 | 2,400 | 16,000 |
| OCT | 13,000 | 0 | 0 | 2,600 | 16,000 |
| NOV | 12,800 | 0 | 0 | 2,300 | 15,000 |
| DEC | 14,000 | 0 | 0 | 3,100 | 17,000 |

TABLE 14

PROJECT CONDITIONS, MISSISSIPPI RIVER,
AVERAGE MONTHLY DISCHARGE IN CFS, EAST BANK, SOUTHWEST PASS

| Month | Over Bank | Outlets (Existing) | Outlets (Proposed) | Total |
|---|---|---|---|---|
| JAN | 0 | 10,700 | None | 11,000 |
| FEB | 0 | 12,100 | | 12,000 |
| MAR | 0 | 24,900 | | 25,000 |
| APR | 0 | 31,400 | | 31,000 |
| MAY | 0 | 26,000 | | 26,000 |
| JUN | 0 | 19,200 | | 19,000 |
| JUL | 0 | 12,400 | | 12,000 |
| AUG | 0 | 6,600 | | 7,000 |
| SEP | 0 | 6,200 | | 6,000 |
| OCT | 0 | 6,000 | | 6,000 |
| NOV | 0 | 5,900 | | 6,000 |
| DEC | 0 | 6,400 | | 6,000 |

TABLE 15

*PROJECT CONDITIONS, MISSISSIPPI RIVER,*

AVERAGE MONTHLY DISCHARGE IN CFS, WEST BANK, SOUTHWEST PASS

| Month | Over Bank | Outlets *(Existing)* | Outlets *(Proposed)* | Total |
|---|---|---|---|---|
| JAN | 0 | 13,400 | None | 13,000 |
| FEB | 0 | 16,500 | | 17,000 |
| MAR | 0 | 34,300 | | 34,000 |
| APR | 0 | 40,500 | | 41,000 |
| MAY | 0 | 35,600 | | 36,000 |
| JUN | 0 | 26,200 | | 26,000 |
| JUL | 0 | 15,300 | | 15,000 |
| AUG | 0 | 9,700 | | 10,000 |
| SEP | 0 | 8,600 | | 9,000 |
| OCT | 0 | 8,200 | | 8,000 |
| NOV | 0 | 8,000 | | 8,000 |
| DEC | 0 | 8,800 | | 9,000 |

TABLE 16

COMPARISON BETWEEN EXISTING AND PROJECT FLOW DISTRIBUTION
EAST BANK, VENICE TO THE HEAD OF PASSES

| Month | Total Q Existing (cfs) | Total Q Project (cfs) | Diff. Q (cfs) | Diff.Q (%)* |
|---|---|---|---|---|
| JAN | 210,000 | 212,000 | +2,000 | +1 |
| FEB | 330,000 | 332,000 | +2,000 | +1 |
| MAR | 430,000 | 461,000 | +31,000 | +7 |
| APR | 457,000 | 510,000 | +53,000 | +12 |
| MAY | 420,000 | 475,000 | +55,000 | +13 |
| JUN | 331,000 | 358,000 | +27,000 | +8 |
| JUL | 213,000 | 223,000 | +10,000 | +5 |
| AUG | 177,000 | 181,000 | +4,000 | +2 |
| SEP | 168,000 | 171,000 | +3,000 | +2 |
| OCT | 163,000 | 165,000 | +2,000 | +1 |
| NOV | 160,000 | 162,000 | +2,000 | +1 |
| DEC | 176,000 | 178,000 | +2,000 | +1 |
| 12-month average | 270,000 | 286,000 | +16,000 | +6% |

* Percentages have been rounded to nearest whole percent

TABLE 17

COMPARISON BETWEEN EXISTING AND PROJECT FLOW DISTRIBUTION, WEST BANK, VENICE TO THE HEAD OF PASSES

| Month | Total Q Existing (cfs) | Total Q Project (cfs) | Diff. Q (cfs) | Diff. Q (%)* |
|---|---|---|---|---|
| JAN | 23,000 | 20,000 | -3,000 | -13 |
| FEB | 32,000 | 29,000 | -3,000 | -10 |
| MAR | 82,000 | 52,000 | -30,000 | -37 |
| APR | 130,000 | 72,000 | -58,000 | -45 |
| MAY | 121,000 | 56,000 | -65,000 | -54 |
| JUN | 67,000 | 40,000 | -27,000 | -45 |
| JUL | 31,000 | 25,000 | -6,000 | -19 |
| AUG | 23,000 | 17,000 | -6,000 | -26 |
| SEP | 20,000 | 16,000 | -4,000 | -20 |
| OCT | 18,000 | 16,000 | -2,000 | -11 |
| NOV | 17,000 | 15,000 | -2,000 | -12 |
| DEC | 20,000 | 17,000 | -3,000 | -15 |
| 12-month average | 49,000 | 31,000 | -18,000 | -37% |

* Percentages have been rounded to nearest whole percent.

TABLE 18

COMPARISON BETWEEN EXISTING AND PROJECT FLOW DISTRIBUTION
EAST BANK, SOUTHWEST PASS

| Month | Total Q Existing (cfs) | Total Q Project (cfs) | Diff. Q (cfs) | Diff. Q (%)* |
|---|---|---|---|---|
| JAN | 18,000 | 11,000 | -7,000 | -39 |
| FEB | 24,000 | 12,000 | -12,000 | -50 |
| MAR | 40,000 | 25,000 | -15,000 | -38 |
| APR | 55,000 | 31,000 | -24,000 | -44 |
| MAY | 53,000 | 26,000 | -27,000 | -51 |
| JUN | 35,000 | 19,000 | -16,000 | -46 |
| JUL | 18,000 | 12,000 | -6,000 | -33 |
| AUG | 15,000 | 7,000 | -8,000 | -53 |
| SEP | 13,000 | 6,000 | -7,000 | -54 |
| OCT | 15,000 | 6,000 | -9,000 | -60 |
| NOV | 14,000 | 6,000 | -8,000 | -57 |
| DEC | 17,000 | 6,000 | -11,000 | -65 |
| 12-month average | 26,000 | 14,000 | -12,000 | -46 |

* Percentages have been rounded to nearest whole percent.

TABLE 19

COMPARISON BETWEEN EXISTING AND PROJECT FLOW DISTRIBUTION,
WEST BANK, SOUTHWEST PASS

| Month | Total Q Existing (cfs) | Total Q Project (cfs) | Diff. Q (cfs) | Diff. Q (%)* |
|---|---|---|---|---|
| JAN | 14,000 | 13,000 | -1,000 | -7 |
| FEB | 20,000 | 17,000 | -3,000 | -15 |
| MAR | 30,000 | 34,000 | +4,000 | +13 |
| APR | 36,000 | 41,000 | +5,000 | +14 |
| MAY | 34,000 | 36,000 | +2,000 | +6 |
| JUN | 24,000 | 26,000 | +2,000 | +8 |
| JUL | 14,000 | 15,000 | +1,000 | +7 |
| AUG | 12,000 | 10,000 | -2,000 | -17 |
| SEP | 11,000 | 9,000 | -2,000 | -18 |
| OCT | 11,000 | 8,000 | -3,000 | -27 |
| NOV | 11,000 | 8,000 | -3,000 | -27 |
| DEC | 13,000 | 9,000 | -4,000 | -31 |
| 12-month average | 19,000 | 19,000 | 00 | 00% |

* Percentages are rounded to the nearest whole percent.

TABLE 20

COMPARISON BETWEEN THE MISSISSIPPI RIVER EXISTING AND PROJECT FLOW DISTRIBUTION, VENICE TO THE GULF[1/]

| | East Bank Venice to HP[2/] | East Bank SW Pass | West Bank Venice to HP | West Bank SW Pass |
|---|---|---|---|---|
| Low flow (November) | | | | |
| Existing Overbank + Outlets, cfs | 160,000 | 14,000 | 17,000 | 11,000 |
| Project cfs | 162,000 | 6,000 | 15,000 | 8,000 |
| % Change with Project | +1 | -57 | -12 | -27 |
| High flow (April) | | | | |
| Existing Overbank + outlets, cfs | 457,000 | 55,000 | 130,000 | 36,000 |
| Project, cfs | 510,000 | 31,000 | 72,000 | 41,000 |
| % Change with Project | +12 | -44 | -45 | +14 |
| 12-month average flow | | | | |
| Existing overbank + outlets, cfs | 270,000 | 26,000 | 49,000 | 19,000 |
| Project, cfs | 286,000 | 14,000 | 31,000 | 19,000 |
| % Change with Project | +6 | -46 | -37 | -0 |

1/ See Tables 2-5, 12-15, 16-19 for complete data; percentages have been rounded.

2/ Head of Passes

3.1.6.1. East Bank, Venice to Head of Passes

Under the existing conditions, the significant Mississippi River discharge into wetlands on the east bank is through Cubits Gap, Baptiste Collette, Pass a Loutre, and South Pass distributaries and two outlets located at river miles 4.9 and 6.45 AHP (Plate 1). There is no significant overbank flow in this river reach at present. The project construction would result in a slight increased river flow through the distributaries throughout the year (Table 12). The river discharge through the two outlets would be similar to that under existing conditions (compare Tables 2 and 12 for these data). The total flow increase to the delta on the east bank (overbank + outlet + distributary) with the project would range from 1 to 13 percent of the existing flow (2,000 to 55,000 cfs increase, Table 16). On an annual basis, 6 percent more than the existing discharge (an increase of 16,000 cfs) would be entering the delta on the east bank between Venice and Head of Passes (Table 20). The impacts of the increased inputs to the delta on water circulation, water quality, marsh vegetation, and fisheries resources are discussed later.

3.1.6.2. West Bank, Venice to the Head of Passes

At present, river-water discharge to wetlands on the west bank occurs through Grand Pass distributary, three outlets located at river miles 3.8, 6.9, and 7.0 AHP, and overbank flows between river miles 1.2 and 4.0 AHP (Plate 1). Under the project conditions, overbank flow would be eliminated except during the high-flow periods of April and May (Table 13). The three existing outlets would be closed. To provide some freshwater flow to the adjacent wetlands, four low-weir rock structures distributed along the lower west bank between river miles 2.9 and 7.1 AHP would be built. During October to February, the total river-water flow (Grand Pass + proposed outlets) to wetlands on the west bank between Venice and the Head of Passes after project completion would be

about 12 percent less or a reduction of about 2,600 cfs (Table 17). However, a significant reduction (ranging from 19 to 54 percent of existing flow, a decrease of 6,000 to 65,000 cfs) of the existing flow to wetlands would occur during March through September as a result of project completion. Overall, an annual reduction of 37 percent of the existing flow (a decrease of 18,000 cfs) to the wetlands would occur as a result of project completion (Table 20).

3.1.6.3. East Bank, Southwest Pass

Under existing conditions, a portion of the river flow in Southwest Pass is discharged into the adjacent wetlands through outlets located at river miles 3.1, 3.4, 3.8, 4.5, and 14.5 BHP (Plate 1). In addition, from March to September, river water is also discharged to the adjacent wetlands through overbank flow at river miles 4.8, 5.7, and 9.0 BHP. After the completion of project training works, this overbank flow to the east delta would be cut off. Outlets located at river miles 3.1, 3.4, and 3.8 would be closed. The river water discharge through the two remaining outlets at river miles 4.5 and 14.5 BHP would be 33 to 65 percent less with project than the total existing flow to the east bank of Southwest Pass (a decrease of 6,000 to 27,000 cfs, Table 18). The 12-month average river-water input to the east bank would be reduced by 46 percent of the existing flow after project completion (Table 20). Freshwater flows through South Pass into East Bay would be slightly increased with the project.

3.1.6.4. West Bank, Southwest Pass

Under the existing conditions, river-water inputs to wetlands on the west bank occur through existing outlets located at river miles 2.1, 3.0, and 9.8 BHP and through overbank discharges during high- and medium-flow periods of April through July (Plate 1). Project completion would eliminate overbank flow and close two outlets at river miles 2.1

and 3.0 BHP. However, higher river stages with the project and, hence, more flow through the outlet at river mile 9.8 BHP, might compensate for the loss of the overbank and the two outlets' flow. Data presented in Table 19 indicate that the highest percent reduction in the water flow to west bank would occur during October to December (a decrease of 3,000 to 4,000 cfs). Overall, no change from the existing flow to overbank areas would occur as a result of Supplement No. 2 project completion (Table 20).

3.1.7. Summary of Overbank River Flow - Project Conditions

The construction of training works would result in the elevation of river stages between Venice and the Head of Passes and in the Southwest Pass below the Head of Passes. Computations predicting project conditions indicate that on an average more of the river flow at Venice would be passing through each of the six major distributaries as a result of project completion. In terms of percent of their individual flow, each distributary would be increased as follows: Baptiste Collette (10 percent), Grand Pass (8 percent), South Pass (2 percent), Southwest Pass (2 percent), and Pass a Loutre (2 percent), and Cubits Gap (11 percent). This increase to the passes is the result of a similar reduction of overbank flow to the west delta between Venice and Head of Passes and closure of outlets along Southwest Pass. The average annual deviation from the total existing flows to the wetlands in the four study units would be as follows:

East Bank, Venice to HOP = 6 percent increase (16,000 cfs increase)

West Bank, Venice to HOP = 37 percent decrease (18,000 cfs decrease)

East Bank, Southwest Pass, HOP to the gulf = 46 percent decrease (12,000 cfs decrease)

West Bank, Southwest Pass, HOP to the gulf = no change

### 3.2. Project Circulation Patterns

3.2.1. Increasing distributary outflow in one area of the delta while decreasing or eliminating outlet or overbank flow in another area might bring about localized changes in circulation of inshore waters, but would not affect major circulation patterns in nearshore or offshore waters. For instance, the elimination of overbank flow and the reduction in outlet flow along the west bank of the river from Venice to Head of Passes would alter the pressure gradient and enable the gulf to exert a greater influence on these west delta marsh waters during low-river discharges. Because the normal pressure exerted by the outflowing fresh water upon the surface gulf waters would be greatly reduced, this would allow gulf waters to penetrate farther inshore than at present. Stratification and two-layered flow would be reduced, and tidal action would then become a more important influence on these west delta marsh waters than river discharge. A similar effect would occur in East Bay at all river discharges because of reduced outlet flow from Southwest Pass. However, overall circulation patterns as far as surface directional flow is concerned would not change in either the east or west deltas.

### 3.3. Project Salinity Distributions

#### 3.3.1. West Delta

3.3.1.1. During low-flow periods, the area between Venice and Head of Passes would experience a 12 percent decrease in distributary and outlet flow, a change of 2,600 cfs. Dispersed over such a wide area, the effect on the positions of the three isohalines would be slight as shown on Plate 3. Along the west bank of Southwest Pass, low-river outlet flow would be decreased about 27 percent, but the change of about 3,000 cfs would be felt only along the upper half of Southwest Pass where the nearshore 2 °/oo and 15 °/oo isohalines might move about 1,500 feet

closer to shore (Plate 3). Because all of the Southwest Pass outlet flow along the west bank would be channeled out of W-2 and flow westward, there would be little change in the isohalines southwest of W-2 at low flow.

3.3.1.2. At medium-river discharges, the Venice to Head of Passes reach would have a 19 percent reduction (July) in outlet and distributary flow (6,000 cfs), and the Southwest Pass outlets at miles 2.1 and 3.0 BHP would be closed which would cause the 2 °/oo isohaline to move about 1,000 to 4,500 feet inland just north of the W-2 outlet (Plate 4). This isohaline would show no change or move only a few hundred yards gulfward west of Grand/Tiger Pass because of the 8 percent increase in distributary flow. The 15 °/oo isohaline lying offshore of the west delta would essentially show no change because of its distance out into the Mississippi Bight.

3.3.1.3. At high-river stages, the entire west delta waters are basically fresh with the 1 °/oo isohaline lying up to several miles offshore of the fringing marshes (Plate 5). A 54 percent decrease (May) in distributary, overbank, and outlet flow from Venice to Head of Passes (65,000 cfs) with the project would not have as great an effect as one would anticipate on the 1 °/oo isohaline because the high-gulf stage during the spring high-flow months and the tremendous freshwater outflow from distributaries, outlets, and overbanks tend to counteract each other. The 14 percent increase in outlet flow below Head of Passes plus the 8 percent increase in flow from Grand/Tiger Pass would move generally westward and partially compensate for the cutoff of most overbank flow and the reduced outlet flow in the west side of the river between Grand Pass and Head of Passes. The west delta marshes would not experience any impact from project conditions because the whole area is fresh and would remain fresh under project conditions.

3.3.2. East Delta

3.3.2.1. With an average 6 percent increase in discharge through the major distributaries and minor outlets on the east side of the river between Baptiste Collette and Head of Passes, conditions would become slightly fresher year-round in these east delta marsh waters. At low flows, a 1 percent, or 2,000 cfs, increase over existing distributary and outlet flow would cause no apparent change to the isohalines (Plate 3). In East Bay, between Southwest Pass and South Pass, the 15 °/oo isohaline lies in or adjacent to the marshes at low flows, so a 57 percent, or about 8,000 cfs, decrease in existing outlet flow because of the closing of three outlets would move the 15 °/oo isohaline about 15,000 feet farther north on the west side of East Bay (Plate 3). The 2 °/oo isohaline would move about 4,500 feet north on the Southwest Pass side of East Bay. Outflow from South Pass would be increased by about 2 percent during low flow, so isohalines would not be expected to change noticeably along the west side of South Pass (Plate 3).

3.3.2.2. At medium-river stages, distributary and outlet flow from the east bank between Venice and Head of Passes would increase 5 percent (July), or about 10,000 cfs, and the 2 °/oo isohaline, which already lies at the gulfward edge of the marshes or offshore, would be pushed slightly into the gulf (Plate 4). No change would occur between Pass a Loutre and South Pass. East delta marshes would not be affected because they already contain nearly all fresh water at medium flows. East Bay would show a minor change in isohaline location at medium-river discharges. The isohalines on the west side of the bay could shift a few hundred yards northward because of the 33 percent decrease (6,000 cfs) in existing outlet flow, while the 5 °/oo isohaline on the east side might shift gulfward slightly. (Plate 4).

3.3.2.3. During high-river discharges, the entire east delta marsh waters from Baptiste Collette to the east bank of Southwest Pass are

fresh with the 1 °/oo isohaline lying offshore. In East Bay, the 1 °/oo isohaline would remain outside the delta area (Plate 5). East Bay marshes would not experience any impacts from these isohaline shifts.

### 3.4. Project Dissolved Oxygen Concentrations

3.4.1. The DO levels in inland delta marsh waters are not expected to decrease to critical levels for aquatic life (less than 5 mg/l $O_2$) in any area as a result of project construction. With more fresh water entering the east delta marshes, DO levels should be slightly higher (near saturation) year-round. In the west delta and East Bay marshes, slightly more gulf water intrusion (Plates 3, 4, and 5) should not affect DO concentrations since seawater is normally well-aerated (Dr. R. Allen, LSU Coastal Studies Inst., Baton Rouge, pers. comm.).

3.4.2. The project would not affect DO levels in the water of the Mississippi Bight in any measureable way because approximately the same amount of fresh water and nutrients would be entering that area from Southwest Pass, distributary flow and outlet flow, although the exact distribution might vary from the present state. The DO levels in the Mississippi Bight normally range from about 5.5 mg/l $O_2$ to greater than 8 mg/l $O_2$ because of river water input (Turner and Allen, 1983).

### 3.5. Project Nutrient Levels

3.5.1. Changes in river hydrology as a result of project construction would have no impact on ambient levels of nitrogen and phosphorus in the river water discharged to the delta and the gulf. Potential impacts resulting from project completion include changes in nutrient loadings in the various study units (east and west deltas and the gulf) because of redistribution of river flow and altered nutrient concentrations in the nearshore gulf waters as a result of freshwater mixing.

3.5.2. Research studies conducted on the Atlantic and gulf coast salt marshes (Broome et al., 1973; Patrick and Delaune, 1976; Mendelssohn, 1979) indicated that nitrogen was a limiting factor in the vegetation productivity of salt marshes while phosphorus did not affect marsh productivity. Changes in nitrogen loadings as a result of river flow redistribution in the lower delta might cause subtle changes in vegetation productivity over the long term.

3.5.3. East Delta

3.5.3.1. The completion of training works would result in the average annual discharge of 48 percent of river flow at Venice to the east delta compared to 46.1 percent under existing conditions (Table 6). This 2.3 percent increase in river discharge to the east delta would proportionately increase total dissolved nitrogen and phosphorus loadings in the east delta marshes nourished by Baptiste Collette, Cubits Gap, Pass a Loutre, and minor outlet flows. Increased river discharge to the distributaries of the east delta during high-flow periods would also slightly increase nitrogen and phosphorus levels in the low-nutrient nearshore surface gulf waters. The impacts on the nearshore gulf waters during low-flow periods might be minimal. However, no data are available on the existing nitrogen and phosphorus levels in the east delta marshes and the gulf water for any flow period, and no comparison can be made.

3.5.3.2. In the east delta, nourished by river flows from the Southwest Pass, an average annual decrease of 46 percent of the existing river flow would result in net nutrient loss to the marshes and estuarine areas. The relative nutrient loss would be higher during low-flow periods than during high-flow periods. This effect might be offset by the creation of marshes along the east bank of Southwest Pass with dredged material. Created marshes in East Bay along Southwest Pass would contribute nutrients from drainage waters and detritus. Despite a

lack of quantitative nutrient data, it is not expected that a decrease in nutrient supply caused by reduced flow distribution would significantly affect vegetative productivity.

3.5.4. West Delta

3.5.4.1. The sources of river water input to the west delta between Venice and Head of Passes after project completion would include Grand Pass and four new outlets between miles 2.9 and 7.1 AHP and some overbank flow during April and May (Plate 8, Table 13). During low-flow periods (November), there would be a slight decrease in the river flow to the west delta between Venice and Head of Passes under the existing flow (12 percent decrease; 2,000 cfs decrease). This indicates that nitrogen and phosphorus loadings to the marshes in this area would be reduced slightly.

3.5.4.2. During high-flow periods (April), a 45-percent decrease in the existing flow to this area would result in similar reduction of nitrogen and phosphorus loadings to the area. Although this reduction in flow is significant, large volumes of water flowing from the river (72,000 cfs) are likely to increase nutrient levels in the low-nutrient nearshore surface gulf water (1 to 2 miles gulfward). In addition to the nutrients present in the river flow, water flowing through the marshes would carry drainage water rich in nutrients and detritus to the nearshore gulf waters and, hence, increase nutrient levels in the nearshore waters.

3.5.4.3. Therefore, an average annual reduction of 37 percent of existing flow to the west bank between Venice and Head of Passes would result in similar reductions in nutrient loadings, however, because most of this flow decrease would occur during medium- to high-flow periods of March to August. Few adverse impacts of decreased nutrient loadings during these months are expected as a result of project completion.

3.5.4.4. The west bank of Southwest Pass (Head of Passes to the gulf) would experience essentially no reduction in nutrient loadings on an annual basis over the existing conditions. The high-flow period (April) would experience a 14 percent increase while low-flow periods (October - November) would result in a 27 percent decrease in nutrient loadings.

3.5.4.5. The west delta between Venice and the gulf would experience a cumulative reduction in dissolved nitrogen and phosphorus loadings associated with river flow. However, creation of several thousand acres of new marshes in the west delta along the river bank could contribute an equal or greater quantity of nutrients.

3.6. Project Pollutant Levels

3.6.1. The unconfined disposal of dredged material during construction of the various engineering features associated with the project could possibly result in adverse water quality impacts because of the release of toxic contaminants from the disposed river sediments. An evaluation of these possible impacts is based on observed contaminant releases simulated by elutriate tests on sediments collected from the project area as well as the known ambient levels of toxic contaminants in the bed sediments and the behavioral patterns of these contaminants. The following sections describe the methodologies and results of the testing programs utilized in evaluating possible impacts.

3.6.1.1. Three modifications of the standard elutriate test were employed during this study to evaluate the contaminant release potentials from various dredging and disposal activities proposed for the project. Elutriate analyses performed included:

Test 1) Standard elutriate prepared with wet channel sediments from the project area.

Test 2) Modified elutriate prepared with distilled water and air-dried channel sediments.

Test 3) Modified elutriate prepared with oxidized sediments from an existing high-mound disposal area.

3.6.1.2. Data from Test 1 suggested the quality of effluent waters immediately following the discharge of dredge materials. In evaluating potential impacts, additional historical elutriate data (Table 21) were used in characterizing overall expected conditions.

3.6.1.3. Data from Test 2 indicated the quality of runoff and leachate waters from upland disposal mounds, such as proposed for the bank nourishment feature. The data obtained from analyses of the elutriate waters in this test were intended to represent the worst-case leachate quality possible from the short-term aging (one to two years) of upland disposal materials.

3.6.1.4. Data from Test 3 were an indication of the long-term leachate quality from an aged upland disposal site.

3.6.1.5. All samples tested from 1982 sediment and water samples from the project area were analyzed for EPA priority pollutants in the base-neutral-organics and organochlorine-insecticide groups as well as mercury and cadmium. These samples included elutriates of each of the three types listed above. Type 1 elutriates (wet river sediments and native river water) also have been used in previous studies by the U. S. Army Corps of Engineers and the U. S. Geological Survey and were analyzed for the common chlorinated hydrocarbons and trace metals. These data are presented along with the 1982 data in Table 21.

3.6.1.6. Results of Tests

Test 1. The Test 1 elutriate data showed only PCB's, chlordane, and cadmium to exceed detection limits in the elutriates as shown in the following:

| | No. of Samples | Mean Concentration in Elutriate | Range of Values |
|---|---|---|---|
| PCBs ug/l | 3 | 0.83 | 0.62-0.98 |
| Chlordane ug/l | 3 | 0.031 | 0.013-0.043 |
| Cadmium ug/l | 3 | 9.1 | 4.6-17.0 |

These mean values exceed freshwater and marine chronic-toxicity criteria for aquatic organisms and represent immediate short-term chemical releases possible during the highly agitated hydraulic-dredging process. When the historical elutriate data are averaged with the 1982 elutriate data (Table 21), the magnitude of cadmium released on the average decreases slightly but still exceeds freshwater criteria. Average PCB and chlordane elutriate values indicate these pollutants remain the major problem-chlorinated hydrocarbons capable of release. These pollutants exceed the freshwater and marine chronic criteria. The expanded data base (Table 21) shows that dieldrin, DDT, DDE, and lindane have occasionally been detected in elutriates from the area; however, the concentrations for dieldrin and lindane have been barely detectable.

Diazinon has been shown to be a common elutriate constituent; however, diazinon is not extremely toxic and is not classified as a priority pollutant. Although arsenic, chromium, copper, lead, nickel, mercury, and zinc have also been detected with regularity in these elutriates, the concentrations of these contaminants in elutriates is generally less than or about the same as in ambient river water. For many of these trace metals, elutriation actually might reduce the ambient river-water concentration because of adsorption processes.

TABLE 21

ELUTRIATE RELEASE FROM BED SEDIMENTS
IN THE LOWER MISSISSIPPI RIVER
VENICE TO THE GULF OF MEXICO[1]

| Constituent | Average Concentration | No. of Detectable Samples[2] | No. of Samples Reported Below Detectable Limits[3] | Total No. of Samples | Range |
|---|---|---|---|---|---|
| Arsenic | 3.6 | 31 | 2 | 33 | 1.0-25.0 |
| Cadmium | 2.5 | 28 | 6 | 34 | 1.0-25.0 |
| Chromium | 2.3 | 29 | 4 | 33 | 0.0-10.0 |
| Copper | 10.7 | 32 | 1 | 33 | 1.0-60.0 |
| Lead | 1.3 | 29 | 4 | 33 | 0.0-3.0 |
| Mercury | 0.08 | 19 | 3 | 22 | 0.0-0.4 |
| Nickel | 6.7 | 33 | 0 | 33 | 1.0-33.0 |
| Zinc | 10.00 | 31 | 0 | 31 | 0.0-20.0 |
| Chlordane | 0.12 | 5 | 0 | 5 | 0.0-0.4 |
| DDT | 0.012 | 2 | 3 | 15 | 0.000-0.024 |
| DDE | 0.026 | 2 | 3 | 5 | 0.000-0.053 |
| Diazinon | 0.64 | 18 | 3 | 21 | 0.01-1.6 |
| Dieldrin | 0.003 | 2 | 3 | 5 | 0.000-0.006 |
| PCB (total) | 0.69 | 5 | 0 | 5 | 0.0-1.1 |

All data are reported in parts per billion (ug/l)

Notes:

1/ The data utilized in preparing the constituent averages do not necessarily represent all data sources. Data represents only four primary reference sources.

a) USACE (1981b).
b) USACE (1981c).
c) USACE (1982).
d) USGS (1975-1977).

2/ Actual number of samples utilized to derive average constituent concentration.

3/ Number of samples where concentration was not quantified, but reported below detection limits of analytical procedure. In data sources used, not all minimum detection limits were the same for the respective constituents.

Test 2. The results of the dried river sediment elutriate test indicate that constituents capable of leaching from upland disposal mounds are somewhat different from those anticipated from direct river disposal (Test 1). Note that the sediments in both tests originated from the same sampling location in the river. The release of PCB's, DDE, and cadmium in this leachate simulation vary both in type and concentration of contaminants when compared to elutriate Test 1. PCB's are also released in Test 2, but in higher concentration than in Test 1; cadmium represents a reverse trend. No chlordane was found to leach from the dried sediments, while DDE was recorded in a trace amount in Test 2 and not reported in Test 1.

| | Mean Conc. in Elutriate | No. of Samples | Range of Values |
|---|---|---|---|
| PCB ug/l | 1.4 | 3 | 0.9-2.0 |
| DDE ug/l | 0.003 | 3 | 0.001-0.003 |
| Cadmium ug/l | 2.8 | 3 | 0.9-5.8 |

While definite conclusions cannot be drawn from these few data, the possibility is suggested that the dredged sediments, when exposed to a highly oxygenated environment, have different releases than dredged sediments disposed of in aqueous, reduced environments. However, correlation between increased PCB concentrations in dried sediments or the release of one contaminant over another are impractical to draw from this single piece of information.

Test 3. The results of the long-term leachability of upland dredged materials, based on the elutriate releases indicated by elutriate Test 3, tend to suggest that PCB's, chlordane, and cadmium could continue to pose a possible contamination threat to the surrounding environments.

| | Mean Conc. in Elutriate | No. of Samples | Range of Values |
|---|---|---|---|
| PCB's ug/l | 0.7 | 3 | 0.6-0.9 |
| Cadmium ug/l | 5.4 | 3 | 3.4-6.4 |
| Chlordane ug/l | 0.02 | 3 | 0.01-0.03 |

Because the sediments used in this testing procedure were different than those used to simulate the short-term leachate possibilities (Test 2), no comparisons to the increases or decreases in constituent levels are possible. What can be concluded is the fact that aged dredged sediments in upland environments can continue to supply contaminants as leached materials.

## 3.7. Impacts of Specific Project Features

### 3.7.1. Bulkheads, Foreshore Protection Dikes, Lateral Pile Dikes, and Jetties

The proposed bulkheads, foreshore protection dikes, lateral pile dikes, and jetties would not cause significant disruption of bottom sediments, and, therefore, no changes in the ambient water quality would be expected. However, the flotation channel and bank nourishment areas associated with these features would produce some impacts. These impacts are discussed in the following sections.

3.7.2. Flotation Channel

3.7.2.1. Construction of the flotation channels would be accomplished utilizing a barge-mounted dragline, with disposal of approximately two million cubic yards of dredged material into the river. Potential impacts from construction of this feature would be short term and are typified by the release results of Elutriate Test 1.

3.7.2.2. Review of Elutriate Test 1 data indicates that dragline activities could result in the potential release of one toxic metal and two organics at levels which could be harmful to aquatic life. However, elutriate data overestimate water quality impacts expected as a result of dragline activities. Draglines move the dredged material in a relatively undisturbed solid form and would result in lower slurry ratios than those expected in typical hydraulic-dredging operations. Another mitigating factor is that the potential for mobilization of contaminants from dredged sediments to the water column either in dissolved or suspended form is directly associated with the degree of physicochemical changes in the disposal site over those experienced in the predisposal sediments. Saucier et al. (1978) has shown that contaminated sediments removed from a reduced environment and disposed in a similar reduced environment should result in relatively insignificant releases of contaminants either in dissolved or suspended forms.

3.7.2.3. Immediate dilution capacity of the Mississippi River is also an important factor when projecting anticipated impacts on water quality by this proposed feature. Average Mississippi River discharges are such that dilution, dispersion, and transport of released contaminants from dredged material would occur rapidly. Burks and Engler (1978) support this idea by stating that toxic contaminant levels during riverine disposal by draglines should be reduced to an unharmful level in a relatively short period of time depending on the dilution potential of the waterway. Based on the aforementioned factors, utilization of a

dragline, disposal in a similar reduced environment, and the dilution potential of the Mississippi River, the potential release of contaminants associated with construction of this feature should not adversely impact the ambient water quality of the project area nor should bioaccumulation potentials be increased.

3.7.3. Freshwater Outlet Channels

3.7.3.1. Four freshwater outlet channels for the distribution of freshwater to adjacent bays are proposed as an engineering feature of the project. Construction of these channels would involve utilization of barge-mounted draglines with overbank disposal. Potential initial contaminant releases from the dredging and disposal actions of this feature would be similar to the releases typified by Elutriate Test 1 and data compiled from the U. S. Army Corps of Engineers and U. S. Geological Survey studies.

3.7.3.2. As with the flotation channels, various factors must be taken into consideration which would reduce actual levels of contaminant releases and their associated impacts. Two factors previously described, the utilization of barge-mounted draglines and the dilution potential of the Mississippi River, would be significant in reducing final contaminant concentrations as well as lessening their impacts on ambient river water quality. Another factor to consider with several of the outlets is that excavation of these features would involve removal of material which exists in an upland environment. Contact of water and sediment for these channels would be minimal; therefore, any runoff from the disposed material would be similar in quality to that which occurs from rainfall.

3.7.3.3. Contaminants shown to be released in the median and long term, as indicated by the elutriate data (Tests 2 and 3), would be expected to represent the quality of leachate from this overbank disposal site.

Movement of these contaminants from the overbank disposal site would be mainly toward the constructed outlets. Any contaminants moving into the outlets would be subjected to significant dilution by the Mississippi River. Therefore, contaminant releases associated with the freshwater outlet features would not be expected to impact ambient water quality adversely in the project area.

3.7.4. Bank Nourishment

3.7.4.1. This feature, coupled with the foreshore dikes, would serve to create new river and pass banks and thus confine more water to the navigational channel. Short-term impacts associated with this feature would result from construction and periodic maintenance.

3.7.4.2. Construction would involve the discharge of hydraulically dredged sediments obtained from the existing navigational channel or designated borrow areas within the river. The bank nourishment feature would be constructed by pumping these dredged sediments between the foreshore dikes and the river and pass banks and between the jetties and the inner bulkheads. Subsequent periodic disposal would be required to maintain the bank nourishment at its design elevation.

3.7.4.3. Immediate water quality impacts resulting from this construction would be primarily associated with the disposed dredged material effluents. Effluents returning to the river would be rapidly diluted, thereby resulting in no alteration of river water quality. Effluents moving away from the river would be expected to temporarily degrade the shallow bay and estuarine waters. However, sediment particles in the effluent would settle out and the physical forces (tidal regimes, wind, wave action, and currents of the bay and estuarine waters) would result in the reduction of contaminant concentrations in the receiving waters through mixing and dilution.

3.7.4.4. Eventual impacts of the bank nourishment feature would include long-term contaminant releases associated with leaching. Movement of contaminants from these disposal areas is expected to be mainly toward the river rather than the bay waters. Impacts of contaminants migrating into the river would be insignificant because of the dilution capacity of the river.

3.7.5. Marsh Creation

3.7.5.1. The procedures used under the existing 40-foot channel maintenance program provide for the unconfined disposal of hydraulically dredged shoal material into open-water disposal areas adjacent to the river and pass. Marsh is created as a by-product of these disposal procedures. These same disposal procedures would be applied during maintenance of the proposed project. The created marsh would partially offset the projected loss of project area marsh to subsidence and erosion.

3.7.5.2. Contaminants disposed into the newly created marshes would not be expected to mobilize significantly. Some dilution and flushing of these contaminants is expected at the surface of these marshes as a result of tidal flooding and rain-related runoff. In marsh areas not subject to regular inundation by tidal waters, contaminants would be expected to influence the interstitial water quality. Alteration of interstitial water quality could be such that EPA freshwater and saltwater chronic criteria might be exceeded. Contaminants shown to be released are all potentially bioaccumulative in the plants and benthic biota which would establish in these areas. Bioconcentration of these contaminants by the flora and fauna would serve to keep contaminants in areas of the marsh which are not regularly flushed. Flushing of river water throughout the overbank, however, would eventually dilute elevated levels back to near ambient.

3.7.6. Net Effects of Project Pollutant Levels

3.7.6.1. After evaluating each of the individual features proposed for the project based on the available information concerning possible water quality impacts (elutriates), it is concluded that, with the exception of the bank nourishment feature and marsh creation, no long-term water quality impacts are anticipated from construction of project features. Relatively minor, short-term, and highly localized impacts are probable from all of the proposed features, but these impacts should result in no significant water quality degradation.

3.7.6.2. The one aspect which appears to exhibit a potential for more long-term impacts is marsh creation. As concluded from the elutriate data, as well as analysis of interstitial waters taken from dredged disposal marshes in the area, the concern is not so much for the long-term contamination to the surface waters of the marshes, but for the interstitial waters derived from contaminants harbored within the marshes. These waters possibly could contain PCB's, DDE, and cadmium in sufficient concentrations to pose possible short-term toxicity as well as long-term bioavailability concerns to biota associated with the marshes. However, it is likely that flushing of most marshes through tidal or river outlet flow would eventually dilute any elevated levels back to ambient ranges.

3.7.6.3. The associated freshwater outlet structures planned for the west bank above Head of Passes would play an important role in maintaining sufficient flushing in that area. The physical characteristics such as circulation patterns, salinity gradients, and nutrient distributions in the adjacent bays also would be dependent upon these outlets.

3.8. <u>Potential Water Quality Problems with Project</u>

3.8.1. Potentially harmful substances such as toxic metals and pesticides tend to accumulate in sediments. These toxic substances might be bioaccumulated by marsh and aquatic species when contaminated sediments are dredged and disposed of in upland, intertidal, or subaqueous environments. In order to evaluate the bioavailability and bioaccumulation potential of the dredged Mississippi River channel sediments, results of contaminant analysis of dredged marsh sediments, river sediments, bioassays, and marsh plants were examined.

3.8.2. Based on a compilation of analytical data (native water, sediments, and elutriate analyses) from four to five data sources between 1975 and 1982, the following of the 129 priority pollutants were considered to have the most potential bioavailability in dredged sediments in the lower Mississippi River:

| | |
|---|---|
| PCB's | Cadmium |
| Chlordane | Mercury |
| DDT, DDD, DDE | Phthalate Esters |
| Dieldrin | |

3.8.3. Heavy metals and organics not included in the above list were either not detectable in the lower Mississippi River delta sediments or, if present in detectable levels, were not considered of potential concern based on one or more of the rigorously evaluated criteria: toxic contaminant levels in comparison to the EPA water quality criteria for aquatic organisms; physicochemical properties affecting contaminant mobilization and bioavailability; persistence in the environment; and other biological effects.

Table 22 summarizes the data compiled from all sources for these parameters, and Figure 2 shows that, with the exception of phthalate

TABLE 22

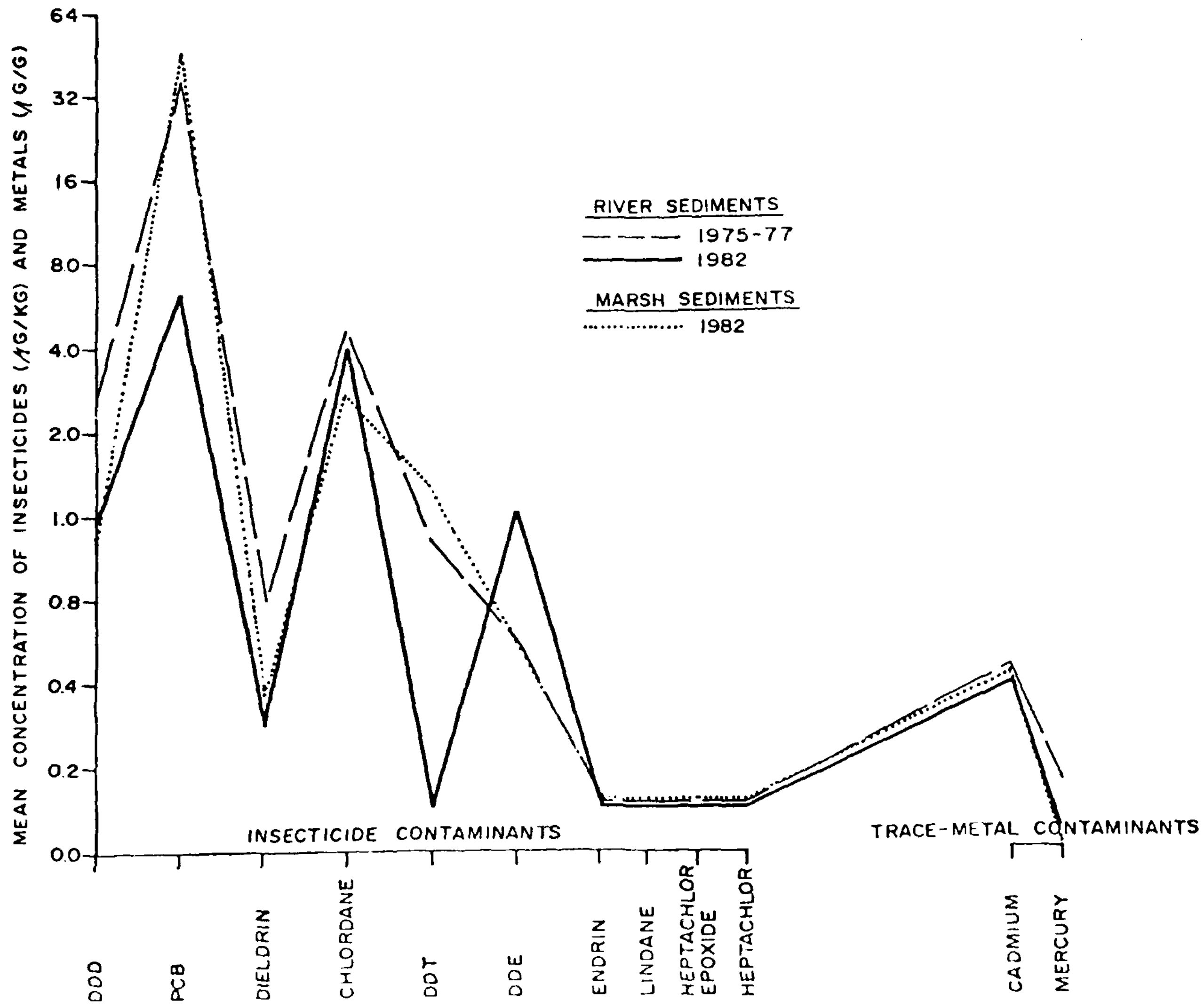
CONTAMINANTS OF POTENTIAL SIGNIFICANCE
IN THE LOWER MISSISSIPPI RIVER DELTA SEDIMENTS[1/]

| Contaminants | River and[2/] Dredged Marsh Sediments (ug/kg) | Dredged Marsh Interstitial Water (ug/l) | Dredged Marsh Plant Tissue (ug/kg) | Dredged Sediment[3/] Bioassay Benthic Tissue (ug/kg) |
|---|---|---|---|---|
| PCB's | 4.4-92.3 | 0.63-3.32 | <0.1-369 | <10-40 |
| Chlordane | <0.1-8.4 | 0.03-0.10 | <0.1-<0.5 | <1-178 |
| DDT | <0.1-3.8 | <0.001 | <0.1 | <0.5-9 |
| DDE | 0.27-0.68 | 0.002-0.007 | <0.1-1.5 | <0.5-1 |
| DDD | 0.46-1.37 | 0.002-0.036 | <0.1-0.2 | <0.5-4 |
| Dieldrin | 0.24-0.64 | <0.002 | <0.1 | <0.5-88 |
| Endrin | <0.1 | <0.002 | <0.1 | <0.5-9 |
| Cadmium | <200-2100 | 1.0-16.0 | <200-1000 | <30-650 |
| Mercury | <20-1600 | 0.3-0.4 | <100-140 | <10-360 |
| Bis-(2-Ethylhexyl) Phthalate | <100-423 | ---- | <100-6274 | ---- |
| Butyl Benzyl Phthalate | <100 | ---- | <100-460 | ---- |
| Diethyl Phthalate | <100-193 | ---- | <100-<400 | ---- |
| Dimethyl Phthalate | <100-1464 | ---- | <100-1271 | ---- |
| Di-n-butyl Phthalate | <100-483 | ---- | <100-<400 | ---- |
| Di-n-octyl Phthalate | <100-483 | ---- | <100-83270 | ---- |
| Heptachlor | ---- | ---- | ---- | <0.5-1 |
| Lindane | ---- | ---- | ---- | <0.5-6 |

< = less than
---- = not analyzed

1/ All data (with the exception of bioassays) were compiled from greenhouse and field sample analysis (USACE, 1982).
2/ Includes lower Mississippi River and dredged marsh sediments.
3/ *Source of data: Bioassays performed by New Orleans District.*

FIGURE 2. "FINGERPRINTS" SHOWING MEAN CONCENTRATIONS OF SELECTED CONTAMINANTS IN MISSISSIPPI RIVER AND MARSH SEDIMENTS.



esters (not measured), these parameters were found in the lower Mississippi River bed sediments in 1975-1977 and in 1982. The 1982 analysis of lower Mississippi River dredged marsh sediments also revealed the same general "fingerprint" as that observed for river bed contaminants. The contaminants presented in Table 22 also were detected in the lower Mississippi River delta dredged marsh plant tissues and/or benthic tissues from dredged sediment bioassays. Most of these contaminants also were detected in the interstitial water of dredged marsh areas. However, three contaminants in Table 22, endrin, lindane, and heptachlor were detected in the bioassay studies but not in the sediments from the dredged marsh or adjacent river bed. Because these three contaminants were not detected in the sediments, they are not considered as potentially significant contaminants in the lower Mississippi River delta.

Table 23 lists specific properties of the potentially significant contaminants which might affect their bioavailability during dredging and disposal operations. These contaminant properties and the data compiled in Table 22 were used in evaluating the bioaccumulation potential of each of these contaminants with respect to upland bank nourishment and intertidal marsh creation disposal situations.

3.8.4. Bank Nourishment

3.8.4.1. Bank nourishment sediments would tend to have coarse-grain particles low in organic matter. This tendency was demonstrated in a recent analysis of an upland disposal site along Southwest Pass where the sediment contained 14 percent silt and clay and only 0.5 percent organic matter. Silt, clay, and organic matter would tend to return to the river during initial disposal, dewatering, and subsequent erosion and runoff. The nine contaminants are reported to be strongly adsorbed to fine sediment fractions and organic matter (Weed and Weber, 1974; Chen et al., 1976; Khalid et al., 1977; Callahan et al., 1979) and,

TABLE 23

PROPERTIES WHICH MIGHT AFFECT THE ECOLOGICAL IMPACT OF SELECTED CONTAMINANTS IN LOWER MISSISSIPPI RIVER DELTA SEDIMENTS

| Parameter | Physicochemical Properties | Persistence In Environment | Bioconcentration Factor (BCF)* |
|---|---|---|---|
| PCB's | Very low solubility. No effects of changes in oxidation-reduction, pH, and salinity conditions on chemical mobility and biodegradation. | Persistent. Resistant to degradation in environment | 1,000-1,240,000 |
| Chlordane | Very low solubility. No effects of changes in oxidation-reduction, pH, and salinity conditions on chemical mobility and biodegradation. | Persistent. Resistant to degradation in environment. Hydroloysis half-life - 4 years. | 10-16,035 |
| DDT,DDD,DDE | Very low solubility. No effects of changes in oxidation-reduction, pH, and salinity conditions on chemical mobility and biodegradation. | Persistent. Resistant to degradation in environment. Persists a minimum of 6 years in environment. | 25-287,000 |
| Dieldrin | Very low solubility. No effects of changes in oxidation-reduction conditions on mobility and biodegradation. | Persistent. Almost no degradation in environment. | 18-236,000 |
| Cadmium | Increasing salinity and decreasing pH reduces adsorption of cadmium to sediments and increases mobility. Acid-oxidizing condition increases release of cadmium from sediments into interstitial and overlying waters. | Persistent. Elemental cadmium is nondegradable. Biological half-life - 30 years. | 3-182,000 |

TABLE 23 (Cont'd)

PROPERTIES WHICH MIGHT AFFECT THE ECOLOGICAL IMPACT OF SELECTED CONTAMINANTS IN LOWER MISSISSIPPI RIVER DELTA SEDIMENTS

| Parameter | Physicochemical Properties | Persistence In Environment | Bioconcentration Factor (BCF)* |
|---|---|---|---|
| Mercury | In aerobic conditions, mercury is less toxic. Acid-oxidizing conditions favor release of mercury from sediments.<br><br>Increasing salinity increases release of mercury from sediments and increases mobility. | Toxic form of mercury not as persistent as other parameters in this table. Volatilization and methylation processes increase mobilization of mercury.<br><br>Half-life - 40-70 days. | 129-33,800 |
| Phthalate Esters | The solubility of the phthalate esters varies from practically insoluble to highly soluble. The short-chain phthalate esters (DMP and DEP) are more soluble forms while the larger chain (BEHP, BBP, DBP, DOP) are more insoluble. | Short-chain phthalate esters biodegrade faster under aerobic conditions than under anaerobic conditions.<br><br>The long-chain esters are less biodegradable. | 14-2,680 |

*BCFs reported are for both freshwater and marine organisms except for phthalate esters for which there were no available data on marine organisms.

Source of information: Edwards, 1973a, b; Duke and Dumas, 1974; Friberg et al., 1974; Von Rumker et al., 1974; Waldichuk, 1974; Weber, 1977; Gambrell et al., 1978; Callahan et al., 1979; McEwen and Stephenson, 1979; Piotrowski and Coleman, 1980; U.S. EPA, 1980.

therefore, would be transported back to the river. This return would not seriously affect river contaminant levels because of the tremendous dilution capacity.

3.8.4.2. The anaerobic dredged sediments deposited at upland disposal sites eventually would oxidize as a result of dewatering, exposure to atmospheric air, and absence of tidal inundation because of higher elevation of the banks. Studies by the Dredged Material Research Program of the U. S. Army Corps of Engineers indicate that oxidation of reduced dredged sediments would mobilize toxic heavy metals such as cadmium that were associated with hydrous oxides of iron and manganese, organic matter and sulfides (Chen et al., 1976; Gambrell et al., 1977; Khalid et al., 1977; Brannon et al., 1978). Cadmium mobilization in the oxidized dredged sediments would increase the potential of cadmium leaching through the surface sediments and back into the river. Some quantity might, however, migrate into the adjacent low-lying marshes.

3.8.4.3. Research studies also indicate that a change from the alkaline reduced sediment environment to acidic oxidized conditions could cause additional cadmium mobilization and, hence, considerable cadmium leaching to the surrounding areas (Brannon et al., 1978; Gambrell et al., 1977, 1978). However, the development of acidic conditions upon oxidation depends on sulfide contents as well as the sediment buffering capacity as a result of carbonates and bicarbonates of calcium and magnesium. The pH of Mississippi River sediments in the Venice to gulf segment (as reflected by the river water data) shifts from neutral to alkaline as the river nears the gulf. The river bottom sediments contain considerable amounts of calcium and magnesium (calcium range, 596 to 5100 ug/g; magnesium range, 1290 to 9500 ug/g; USACE, 1982, unpublished data). No sulfide data for the river sediments are available. However, samples of dredged salt marsh sediments taken from Southwest Pass, mile 10.5 BHP, contained 9.5 to 10.9 ug/g sulfide; those from a naturally accreted salt marsh located at South Pass mile 10 BHP

and East Bay contained 9.5 to 42 ug/g sulfides (USACE, 1982, unpublished data). Apparently, sulfide contents in the dredged sediments are not high enough to neutralize calcium and magnesium carbonates and bicarbonates upon oxidation, and a shift towards acidic pH might not be significant enough to appreciably mobilize cadmium. This conclusion is further supported by the lower Mississippi River water data reported by Dupuy and Couvillion (1979) and USGS (1981). The levels of calcium and magnesium carbonates and bicarbonates in the Southwest Pass and South Pass river water generally were higher than the sulfate levels in the river water elsewhere, and these levels are reflective of the sediment chemistry. The higher buffering capacity of sediments would, therefore, minimize excessive pH reductions upon sediment oxidation and, hence, little additional cadmium mobilization would occur. Therefore, although the oxidation of reduced dredged sediments placed at bank nourishment elevations would result in the mobilization of cadmium, additional cadmium release possible through pH changes appears negligible.

3.8.4.4. The upland disposal sites on the lower Mississippi River do not support marsh vegetation because of their higher elevation; hence, bioaccumulation of the nine contaminants by marsh plants because of bank nourishment and subsequent entry into the food chain does not warrant concern.

3.8.5. Marsh Creation

3.8.5.1. Intertidal delta areas include protected marsh areas with low-energy regimes as well as open-water areas characterized by low- to moderate-energy regimes because of wind-driven currents and tides. The natural marshes in the low-energy regimes are generally colonized by a variety of marsh plants such as *Cyperus spp.*, spikerushes (*Eleocharis spp.*), panic grasses (*Panicum spp.*), roseau (*Phragmites australis*), *Sagittaria spp.*, bulrushes (*Scirpus spp.*), and *Spartina spp.* although specific disposal sites might support other plant species not dominant

in the natural marshes. These intertidal marshes also support benthic and planktonic populations that are a significant food source for Gulf of Mexico fisheries.

3.8.5.2. Oxidation-reduction conditions, pH, and salinity of dredged sediments deposited in the low-energy intertidal zones are controlled largely by the Mississippi River flow levels and tidal effects. For example, during low-flow periods, the salinity levels generally are higher than during the moderate to high-flow periods because of greater relative tidal effect (USACE, 1982, unpublished data). Increased sediment salinity is reported to enhance cadmium mobility because of formation of chloride, sulfate, and carbonate complexes that are more mobile than sulfide complexes and exchangeable cadmium (Gambrell et al., 1978). This cadmium release, however, is counteracted by an increase in pH of dredged sediments because of an increase in salinity levels and because alkaline pH conditions inhibit cadmium mobilization (Gambrell et al., 1978) resulting in no appreciable net cadmium release.

3.8.5.3. Dredged sediments deposited in the upper reaches of the intertidal marshes where the tidal effect is less might develop a thin oxidized layer during low-river flow periods because of exposure to the atmospheric air. However, the bulk of sediment material would remain under reduced conditions minimizing cadmium mobility. The presence of detectable levels of sulfides in the dredged saltmarsh sediments and in the naturally accreted saltmarsh sediments, as indicated in the preceding paragraphs, suggests the presence of reduced sediment conditions.

3.8.5.4. The biodegradation and mobility of organic contaminants are not significantly affected by altered physicochemical characteristics of sediments (Table 23); therefore, relative availability of organic contaminants present in the dredged sediments would not be affected under marsh conditions. Dredged sediments disposed in the moderate

energy submerged areas would maintain reduced conditions, thus minimizing toxic metal mobility.

### 3.8.6. Impact on Marsh Plants

3.8.6.1. Studies of the vegetation stand and biomass production on a recently created dredged-sediment salt marsh and a naturally accreted salt marsh in the lower delta area indicate the salt marshes created by dredged material support significantly greater vegetation growth and biomass production than the natural marsh sediments. Based on these results, it appears that the levels of individual toxic contaminants present in the lower Mississippi River dredged sediments are not high enough to affect initial plant growth adversely. These results also suggest lack of any cumulative adverse effects of contaminants on marsh plants established on dredged sediments.

3.8.6.2. Uptake studies on Spartina alterniflora, from a dredged-sediment salt marsh and a naturally accreted salt marsh, yielded site-specific bioconcentration factors (BCF). An examination of worst-case contaminant biomagnification in the plant tissues indicates that PCB's from the dredged sediments were bioconcentrated by a factor of 13.4 and mercury by a BCF greater than 7.0. No PCB's or mercury were accumulated in plants grown on natural-marsh sediments. Three of the phthalate esters - DEHP, BBP, and DOP - were bioconcentrated from the dredged sediments into plant tissues by BCF's greater than those from the natural marshes.

3.8.6.3. These results suggest that PCB's, mercury, and the phthalate esters DEHP, BBP, and DOP - found in the lower Mississippi River dredged sediments present a potential for bioconcentration by marsh plants growing on dredged sediments at intertidal disposal sites. Chlordane, DDT, DDD, and dieldrin were not bioconcentrated from dredged sediments into plant tissues. Bioconcentration of DDE and cadmium from the

dredged-marsh sediments was comparable to that from the natural-marsh sediments and, therefore, does not present any additional cause for concern because of dredging.

3.8.7. Impact on Aquatic Organisms

3.8.7.1. The disposal of dredged sediments containing toxic contaminants in the low- to moderate-energy intertidal zones might result in significant loss of fine-grained suspended sediments and organic material to adjacent waters because of initial mixing upon disposal and subsequent erosion and tidal action. Constant mixing of the deposited sediments because of tidal and wave action also might result in the release of sediment-bound contaminants to the overlying waters. The disposal of dredged sediments containing toxic contaminants under these conditions might have both short-term and long-term impacts on the benthic and aquatic organisms inhabiting these areas.

3.8.7.2. Sediment elutriate analysis has been used to evaluate short-term contaminant release during dredging and disposal operations. An examination of the worst-case elutriate contaminant release from dredged-bottom sediments collected from various points in the Venice to the Gulf of Mexico segment of the Mississippi River showed that cadmium and chlordane exceeded the EPA acute toxicity criteria established for the protection of freshwater and saltwater aquatic life, respectively. However, dilution of dredged effluents by the intertidal site water because of dispersion and wave action might result in lowering the contaminant concentrations to below acute toxicity levels, and, thus, the harmful effects might be only brief.

3.8.7.3. The results of bioassays conducted on dredged river sediments collected from various points in the lower delta did not show significantly higher mortality of test organisms in the liquid, suspended solids, and solid phase medium compared to the same from the

disposal site. The percent mortality in the reference, as well as dredged sediment medium, was generally below 10 percent. This suggests no short-term acute toxicity effects of contaminants on the aquatic or benthic organisms.

3.8.7.4. The 10-day solid phase bioassay studies were conducted to investigate the contaminant bioaccumulation potential of the lower Mississippi River sediments collected from various sites. The results of these studies indicate that in only one of the six bioassay-bioaccumulation studies, bioaccumulation of cadmium and mercury, by test organisms from the dredged material, was significantly higher than that from the disposal-site material. PCB's, chlordane, DDT, DDD, DDE, and dieldrin were accumulated by test organisms from the solid phase, but differences in the bioaccumulation from the dredged sediments and the disposal-site sediments were not significant or, in cases where statistics were not computed, the differences were very small. Bioassays not reporting statistics for certain parameters showed less than or equal concentrations in test organisms compared to reference organisms, therefore no statistics were necessary. No data were collected on the bioaccumulation of phthalate esters from the lower Mississippi River delta sediments.

3.8.7.5. Comparisons of the worst-case contaminant concentrations present in the bioassay test organisms (Table 22) with the Food and Drug Administration (FDA) "Action" levels established for certain contaminants (1.0 mg/kg for mercury, 5.0 mg/kg for PCB's, and DDT's, and 0.3 mg/kg for chlordane and dieldrin) (FDA, 1979) show that levels of these contaminants in the aquatic organisms would not be toxic if consumed by humans.

3.8.7.6. Based on the elutriate contaminant concentrations and mortality bioassay studies discussed in the preceding paragraphs, it is

concluded that marsh creation with dredged sediments containing low levels of toxic contaminants would have no significant short-term acute toxic effects on the aquatic or benthic organisms. However, the results of contaminant bioaccumulation-bioassay studies suggest the potential for cadmium and mercury bioaccumulation from the dredged sediments.

3.8.7.7. Long-term sublethal chronic toxic effects of low concentrations of contaminants in the lower Mississippi River delta sediments on the filter-feeding and benthic species in the intertidal and nearshore gulf water are difficult to evaluate from the elutriate tests or bioassay studies. The EPA had compiled extensive data on the range of toxic contaminant concentrations that would have long-term chronic effects on various life stages, reproduction, and species behavior of freshwater and saltwater invertebrates and fish species (U.S. EPA, 1980). However, these studies were conducted on the static or flow-through water systems rather than on the sediments, and no relationship has been established between contaminant water concentrations and bulk sediment levels.

3.8.7.8. The sediment interstitial water phase is generally considered to contain a very small fraction of bulk sediment concentration in a soluble form that is immediately available for biological uptake (Chen et al., 1976; Brannon et al., 1978). This sediment liquid phase originates from the water trapped within the sediments or by liberation into solution from the sediment solid phase through diagenetic mobilization[1] processes such as solution, ion exchange, desorption, etc. The benthic and filter-feeding organisms would be exposed to this contaminant fraction and, thus, might incur long-term low-level accumulation.

3.8.7.9. A comparison of the worst-case contaminant levels in the dredged marsh and naturally accreted marsh sediment interstitial water indicates that PCB and cadmium concentrations (1.25 ug/l and 3.32 ug/l

PCB's; 16.0 ug/l and 10.0 ug/l cadmium, respectively) exceeded the levels of these two contaminants (0.15 ug/l PCB's, and 4.8 to 6.4 ug/l cadmium) which had measured chronic effects on saltwater species (U.S. EPA, 1980). However, comparison of marsh sediment interstitial water data indicates that the naturally accreted marsh sediment interstitial water PCB concentration was higher than that of the dredged-material marsh sediment interstitial water concentration. Therefore, the potential chronic adverse impact of PCB's from the dredged sediments on the inhabiting benthic and filter-feeding organisms would not be greater than the natural intertidal sediments. The cadmium level of dredged sediment appears to present a slight potential for chronic adverse effects.

3.8.8. Summary of Bioaccumulation Potential

3.8.8.1. Effluent discharge, dewatering, and erosion from the bank nourishment feature could result in the limited transport of fine sediment material containing contaminants to the adjacent intertidal areas, although most would go riverward. In addition, oxidation of reduced bottom sediments placed at upland sites could result in limited mobility and transport of cadmium to the adjacent marsh areas although, again, most would go riverward.

3.8.8.2. Regarding marsh creation, vegetative growth and contaminant bioaccumulation of marsh plants growing in the dredged-material marsh and naturally accreted marsh sediments were used as criteria to determine the short-term acute toxic effects and bioaccumulation potential of marsh plants after intertidal disposal. The results suggest no short-term acute toxic effects of contaminants present in dredged sediments on marsh vegetation productivity. The plant bioaccumulation results indicate a potential for PCB's, mercury, and the

phthalate esters - DEHP, BBP, and DOP - to bioconcentrate in marsh plants after intertidal disposal.

3.8.8.3. Mortality rates of benthic organisms in bioassay studies and contaminant concentrations in sediment elutriates indicate marsh creation with dredged sediments would have no short-term acute toxic effects on organisms inhabiting the marshes.

3.8.8.4. The results of contaminant bioaccumulation bioassay studies indicate there might be some potential for cadmium and mercury bioconcentration by benthic organisms under intertidal conditions. The comparison of dredged sediment interstitial water levels with the EPA reported levels for chronic impacts suggests some potential for chronic impacts of cadmium on benthic populations after marsh creation.

3.8.8.5. In an effort to gain additional perspective, surveys of data from natural marshes in other areas of the United States were reviewed. Values shown in Table 24 indicate both natural and dredged marshes in the project area compare favorably with marshes in other areas.

3.9. Water Quality Benefits of Project

3.9.1. In Section 2.7, "Existing Water Quality Problems," it was explained how salinity changes and water depth changes are contributing to a tremendous land loss rate in the Mississippi delta. After project completion, these loss rates would continue high, but definite improvements are expected.

3.9.2. At present, saltwater intrudes into the east delta marshes during river flows of less than 350,000 cfs. By slightly raising the

TABLE 24

CONCENTRATION RANGES FOR SELECTED CONTAMINANTS REPORTED IN THE LITERATURE FOR SALTWATER SOILS AND MARSHES

| Contaminant | Source | Medium | Range ppm/ppb | Location | Remarks |
|---|---|---|---|---|---|
| Cd | Brannon et al. (1976 a,b) | Sediment | 1.4-52ppm | Bridgeport, CN | channel sediments |
| | Eisler et al. (1977) | Sediment | 0.06-2.45ppm | Quonset Point, RI | |
| | Stoffers et al. (1977) | Sediment | 1.4-52ppm | New Bedford Harbor, MA | |
| | Folsum et al. (1981) | Sediment | 4.9-52.6ppm | Bridgeport, CN; Baltimore, MD; Corpus Christi, TX; Oakland, CA; Seattle, WA | suspected areas of contamination |
| | Dunstan et al. (1975) | Plant tissue | 0.61ppm (avg) | S. Carolina & Georgia | S. alterniflora |
| | Lee et al. (1978) | Plant tissue | 0-3.5ppm | ten East & Gulf coast marshes | S. alterniflora on dredged material |
| | Folsum et al. (1981) | Plant tissue | 0.05-3.1ppm | grown on sediment cited above | S. alterniflora, controlled conditions |
| | Simmers et al. (1981) | Plant tissue | <0.02-0.72ppm | ten natural marshes adjacent to those cited in Lee et al above | S. alterniflora |
| Hg | Brannon et al. (1976 a,b) | Sediment | 0.52-1.12ppm | Bridgeport, CN | channel sediments |
| | Eganhouse et al. (1978) | Sediment | 0.5-9.0ppm | Palos Verde, CA | |
| | Skei and Paus (1979) | Sediment | 0.04-0.18ppm | Norwegian fjord | core sample |
| | Folsum et al. (1981) | Sediment | 0.11-1.48ppm | Bridgeport, CN; Baltimore, MD; Corpus Christi, TX; Oakland, CA; Seattle, WA | suspected areas of contamination |
| | Dunstan et al. (1975) | Plant tissue | 0.44ppm (avg) | S. Carolina & Georgia | S. alterniflora |
| | Lee et al. (1978) | Plant tissue | 0-0.80ppm | ten East & Gulf coast marshes | S. alterniflora on dredged material |
| | Folsum et al. (1981) | Plant tissue | 0.013-0.032ppm | grown on sediment cited above | S. alterniflora, controlled conditions |
| | Simmers et al. (1981) | Plant tissue | 0-0.15ppm | ten natural marshes adjacent to those cited in Lee et al above | S. alterniflora |
| PCB | Giam et al. (1978) | Sediment | 0.2-35 ppb | Mississippi Delta | |
| | Palmer et al. (1976) | Sediment | 11-1,200 ppb | Chesapeake Bay | |
| | West and Hatcher (1980) | Sediment | 0.6-1,460 ppb | New York Bight | |
| | Hom et al. (1974) | Sediment | 103ppb (avg) | Santa Barbara Basin | marine sediment |
| | Halcrow et al. (1974) | Sediment | 10-2,900 ppb | Firth of Clyde, Scotland | |
| | Strek & Weber (1982) | Plant tissue | .16-13,900ppb | no specific location | vegetables, grasses, weeds |
| | Buckley (1982) | Plant tissue | 30-320ppb | no specific location | terrestrial plants |
| DDT and derivatives | West and Hatcher (1980) | Sediment | <0.2-1.8 ppb | New York Bight | |
| | Palmer et al. (1976) | Sediment | <1.0-273ppb | Chesapeake Bay | |
| | Giam et al. (1978) | Sediment | 0.2-9.3ppb | Mississippi River Delta | |
| | Amico et al. (1979) | Plant tissue | 2.1-20.1ppb | | seaweed |
| | Kaphalia & Seth (1982) | Plant tissue | 248-414ppb | | fodder grasses |
| Dieldrin | Requejo (1979) | Sediment | 2.0-238ppb | Everglades National Park area | |

allocation of water to Baptiste Collette, Cubits Gap, and Pass a Loutre, the project would impede this intrusion.

3.9.3. Through the unconfined disposal of dredged material, the project is estimated to create between 9,000 and 13,600 acres of dredged-material marshes. The majority (7,400 acres) would be created west of the navigational channel where land loss rates are greatest. These marshes would add nutrients, detritus, and valuable habitat to an area which is presently declining.

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AD-A141 213 MISSISSIPPI RIVER BATON ROUGE TO THE GULF LOUISIANA PROJECT SUPPLEMENT II(U) ARMY ENGINEER DISTRICT NEW ORLEANS LA APR 84

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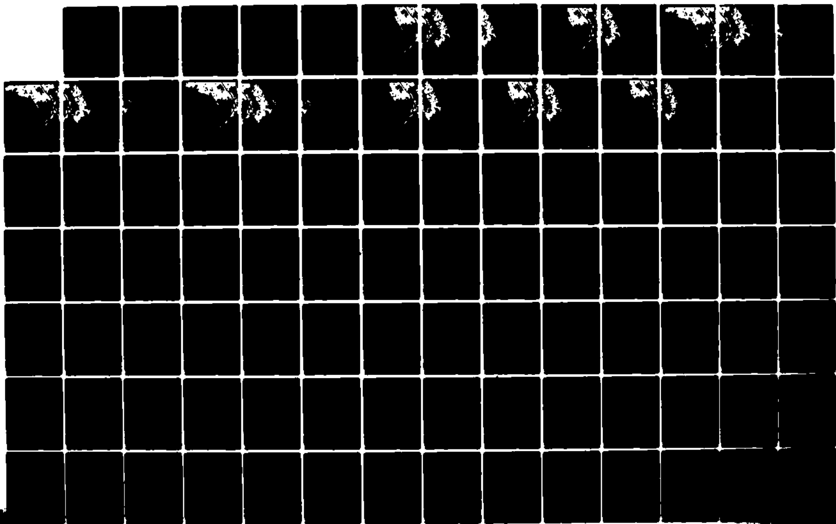

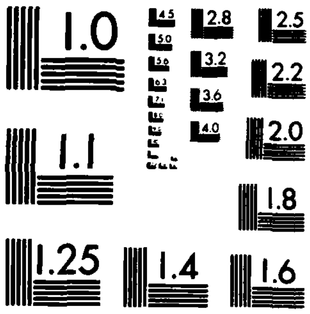


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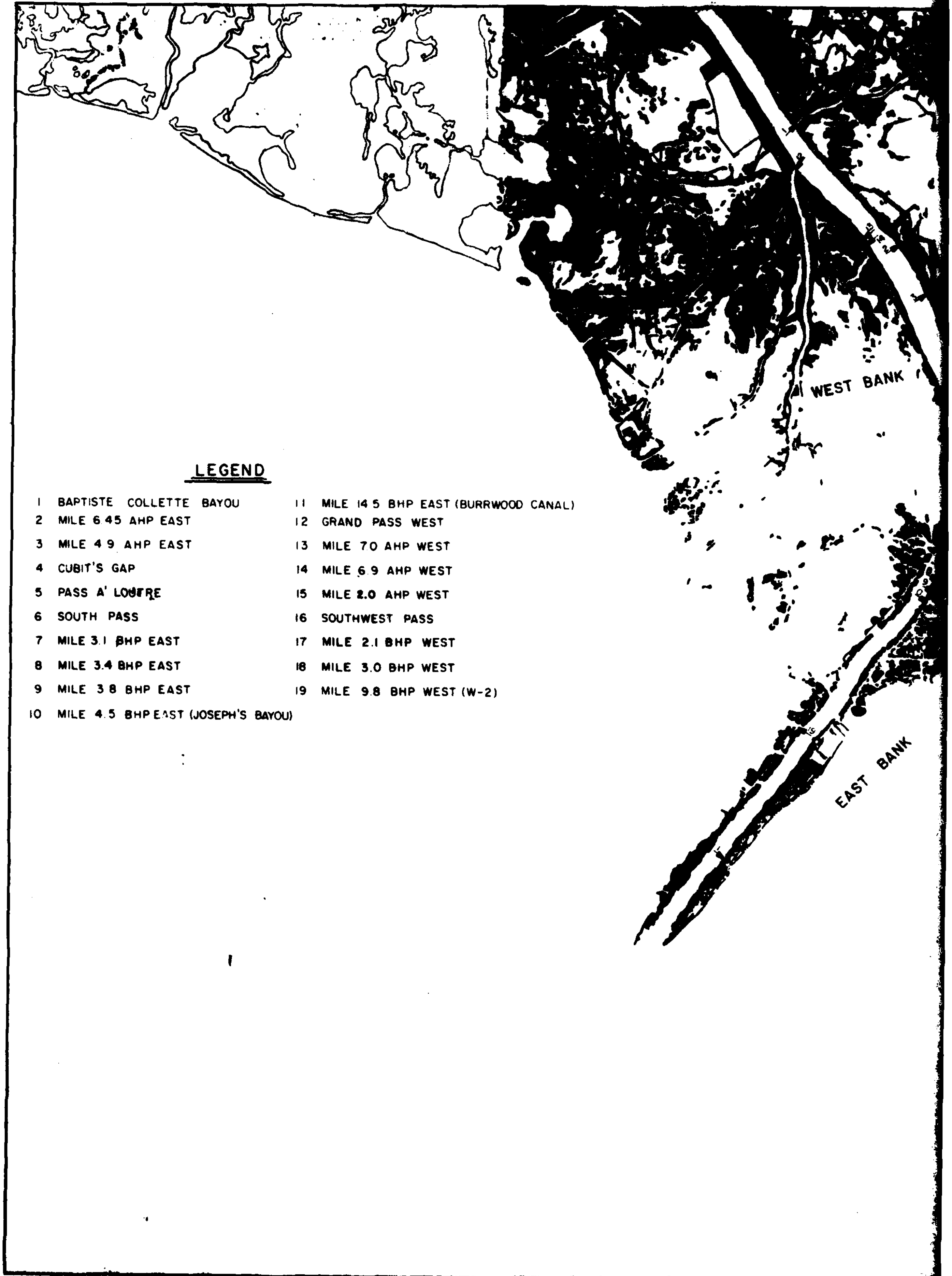
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2 MILE 6.45 AHP EAST
3 MILE 4.9 AHP EAST
4 CUBIT'S GAP
5 PASS A' LOUTRE
6 SOUTH PASS
7 MILE 3.1 BHP EAST
8 MILE 3.4 BHP EAST
9 MILE 3.8 BHP EAST
10 MILE 4.5 BHP EAST (JOSEPH'S BAYOU)
11 MILE 14.5 BHP EAST (BURRWOOD CANAL)
12 GRAND PASS WEST
13 MILE 7.0 AHP WEST
14 MILE 6.9 AHP WEST
15 MILE 2.0 AHP WEST
16 SOUTHWEST PASS
17 MILE 2.1 BHP WEST
18 MILE 3.0 BHP WEST
19 MILE 9.8 BHP WEST (W-2)


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SCALE-FEET

MAP SOURCE U S FISH AND WILDLIFE SERVICE, 1978 "WETLAND CHANGES IN THE MISSISSIPPI RIVER ACTIVE DELTA (1956-1978)" NATIONAL COASTAL ECOSYSTEM TEAM, SLIDELL, LA AND BURK & ASSOCIATES, 1976 PLAQUEMINE PARISH, LA "HYDROLOGIC CHARACTERISTICS"

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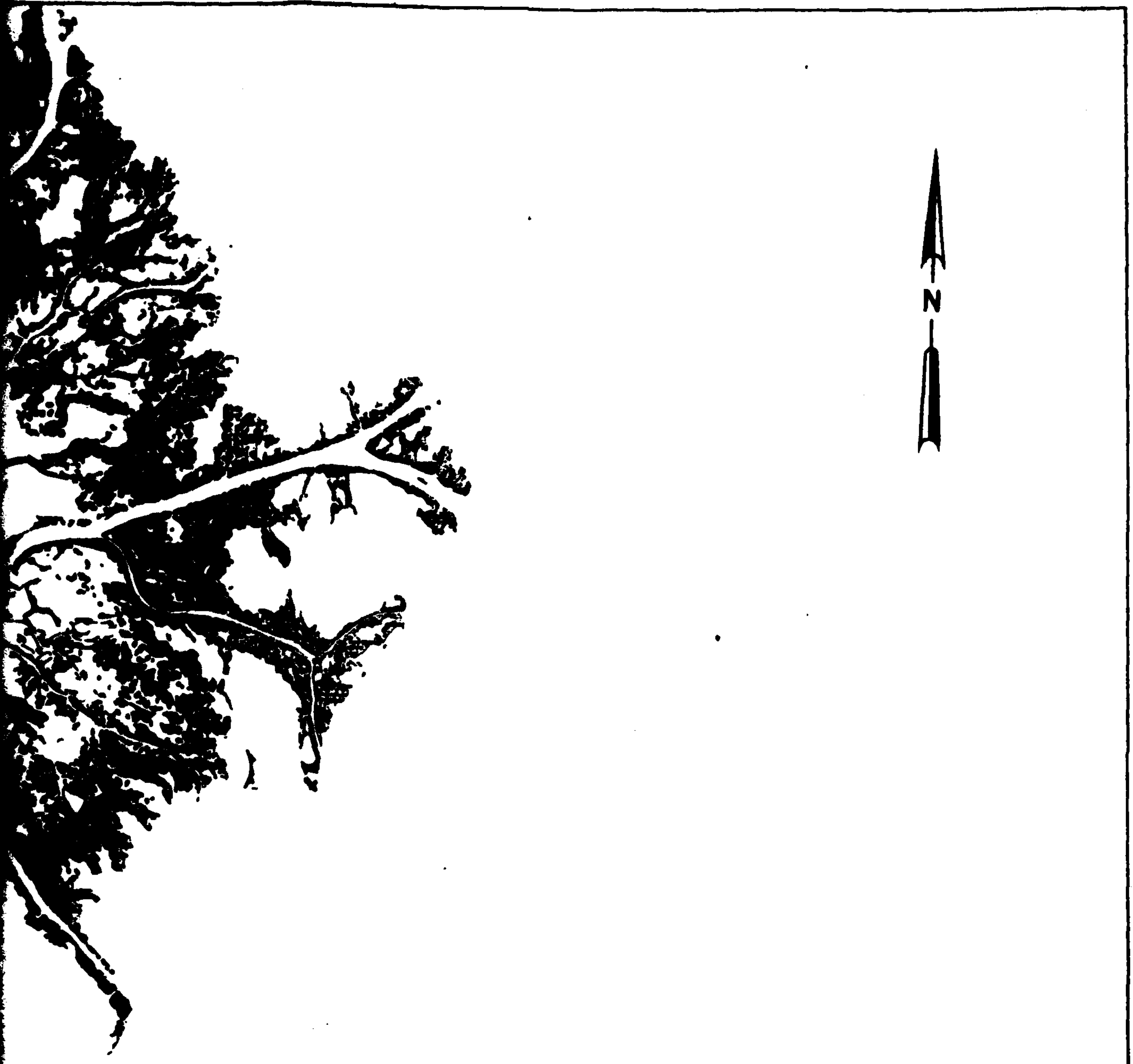


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MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO, LA
(SOUTHWEST PASS & BAR CHANNEL)

WATER QUALITY APPENDIX

SUPPLEMENT NO. 2

# EXISTING OUTLETS & DISTRIBUTARIES IN LOWER MISSISSIPPI RIVER

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U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

APRIL 1984

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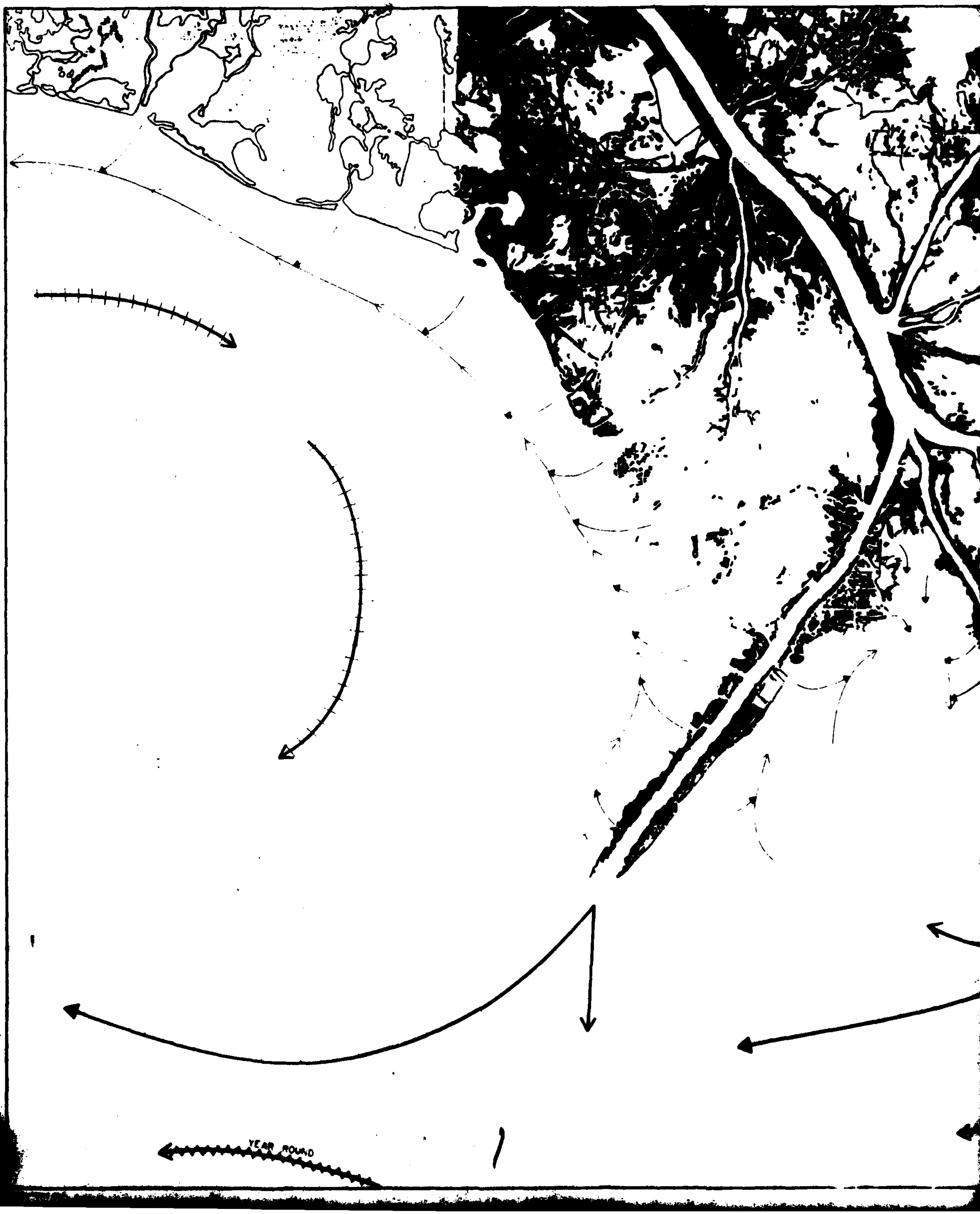
PLATE 1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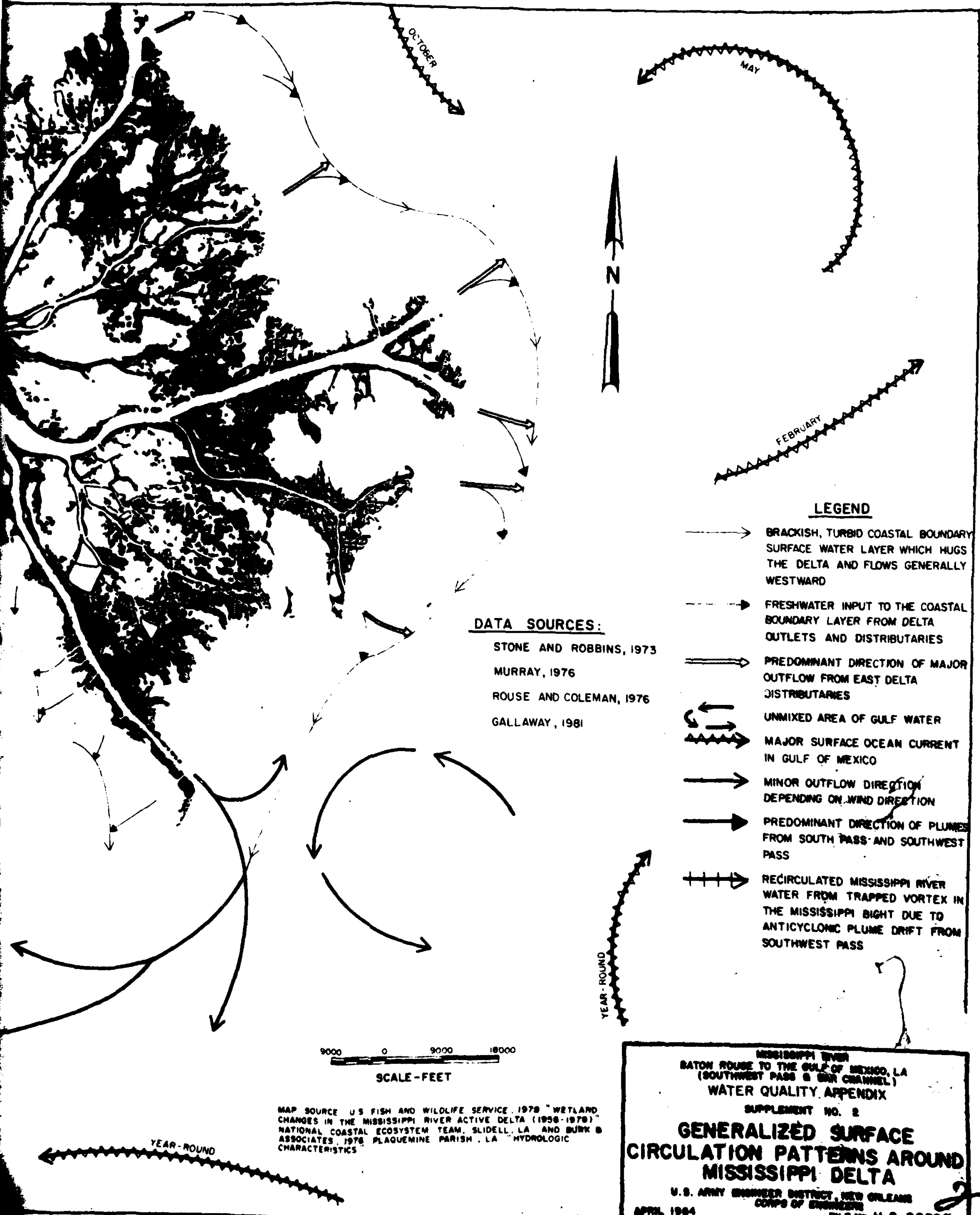


MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO, LA
(SOUTHWEST PASS & BAR CHANNEL)
WATER QUALITY APPENDIX
SUPPLEMENT NO. 2

# GENERALIZED SURFACE CIRCULATION PATTERNS AROUND MISSISSIPPI DELTA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
APRIL 1984
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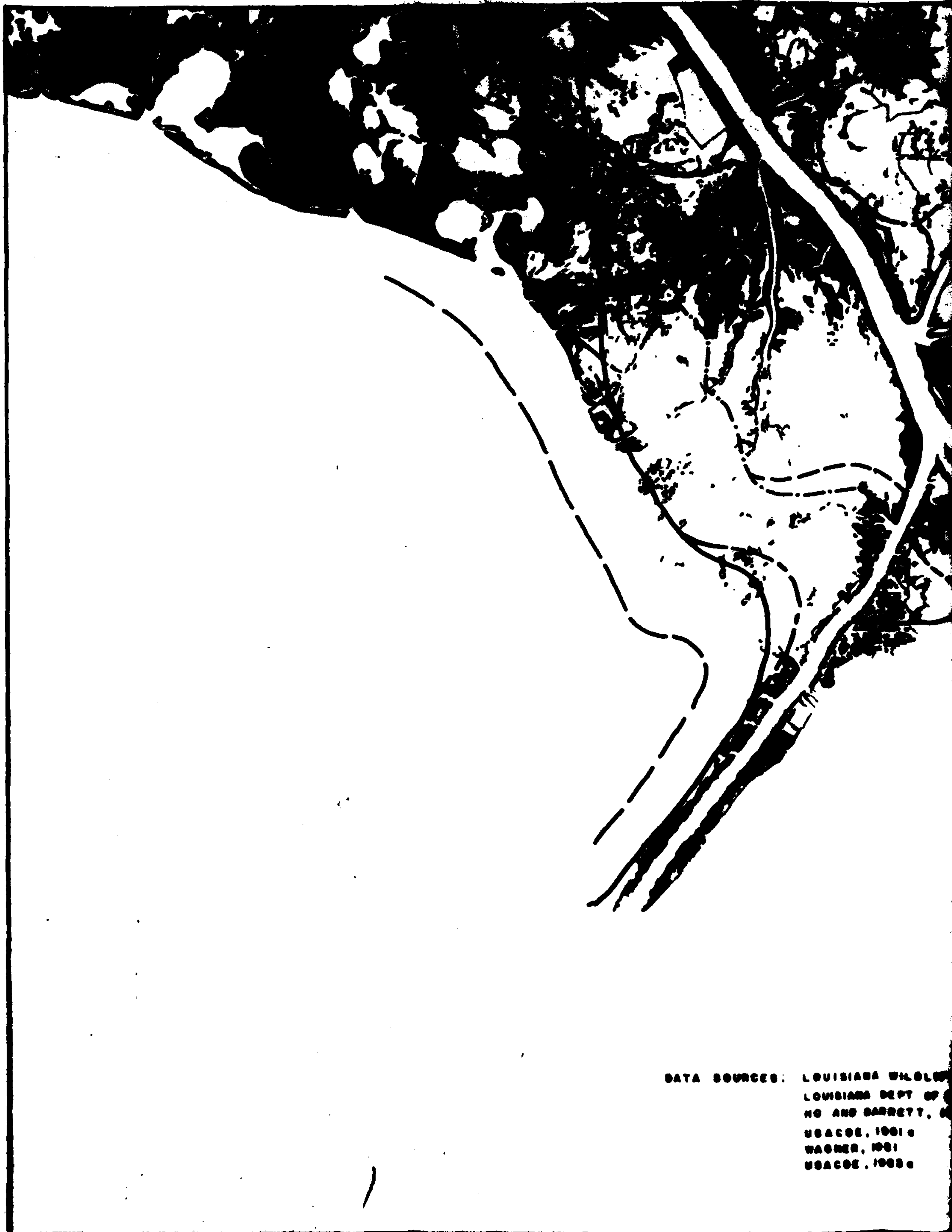
PLATE 2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LEGEND

EXISTING CONDITIONS

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- < 15 PPT
- < 30 PPT

CHANGE DUE TO PROJECT

- < 2 PPT
- < 15 PPT

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SCALE-FEET

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MISSISSIPPI RIVER
BATON ROUGE TO THE GULF OF MEXICO, LA.
(SOUTHWEST PASS & BAR CHANNEL)
WATER QUALITY APPENDIX
SUPPLEMENT NO. 2
AVERAGE LOW FLOW (260,000 CFS)
SALINITY DISTRIBUTION IN AND AROUND
THE ACTIVE MISSISSIPPI RIVER DELTA
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

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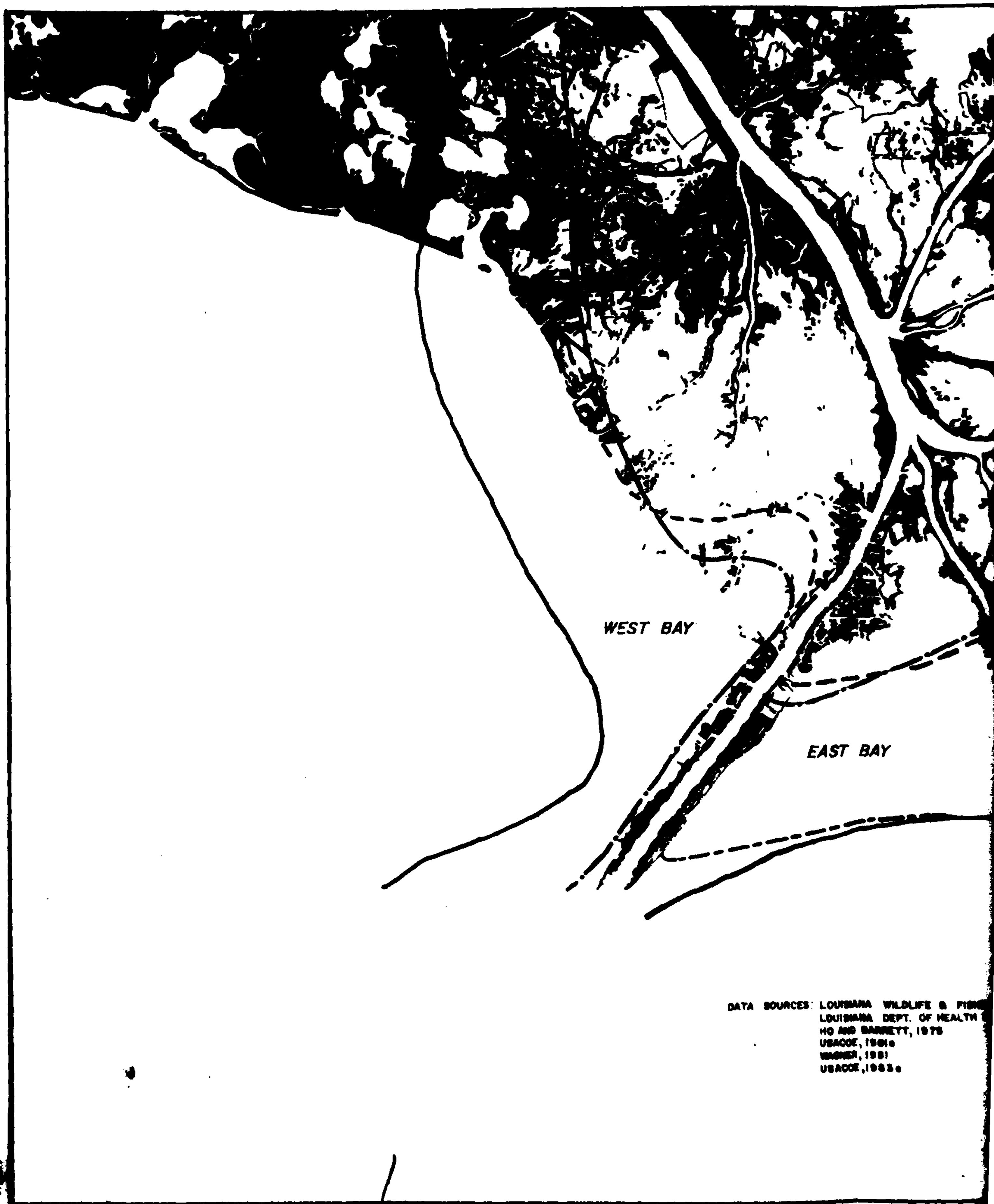
PLATE 3




DATA SOURCES: LOUISIANA WILDLIFE & FISH
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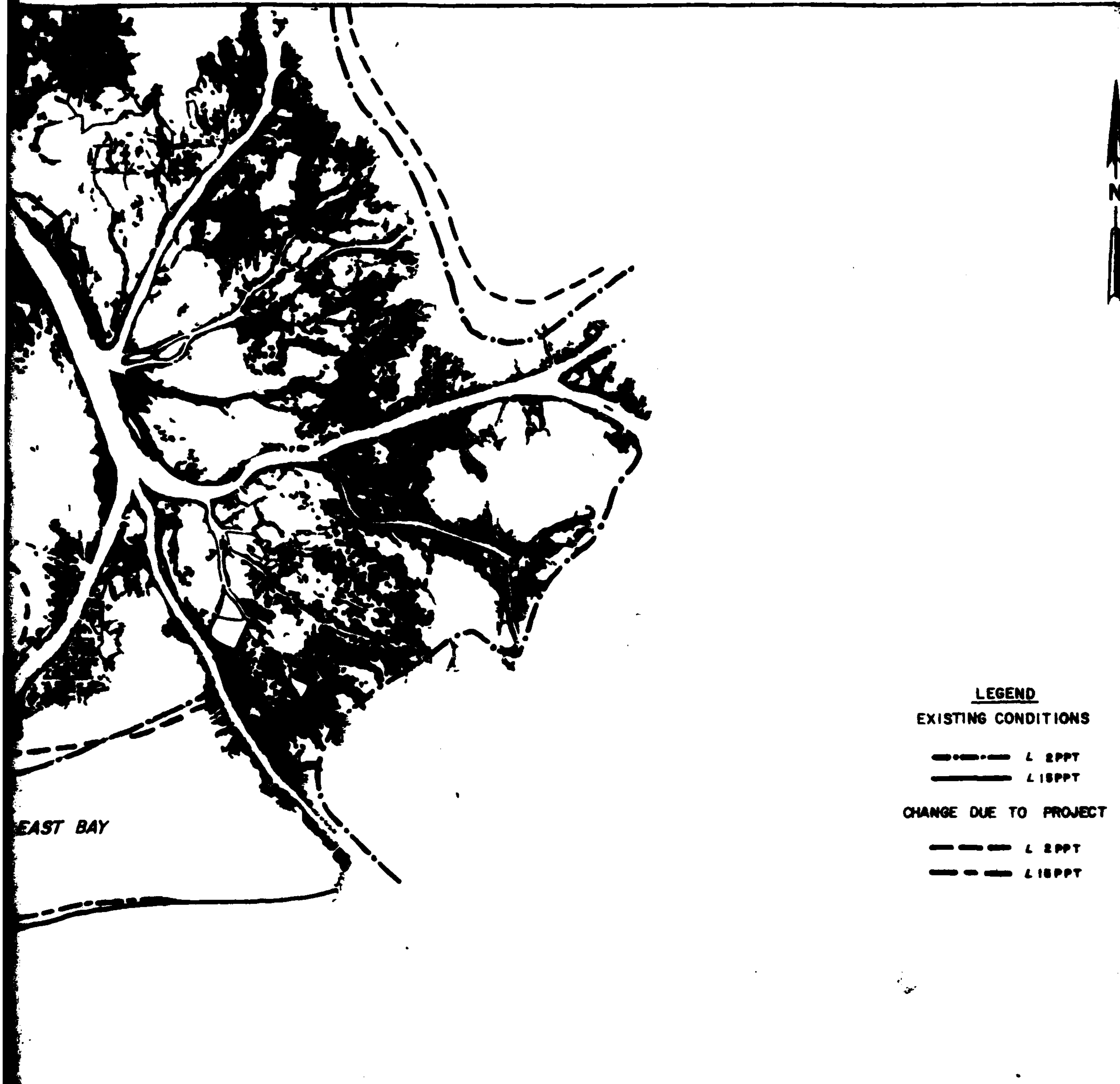


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SCALE-FEET

MAP SOURCE U.S. FISH AND WILDLIFE SERVICE, 1978 "WETLAND CHANGES IN THE MISSISSIPPI RIVER ACTIVE DELTA (1956-1978)" NATIONAL COASTAL ECOSYSTEM TEAM, SLIDELL, LA AND BURK & ASSOCIATES, 1976 PLAQUEMINE PARISH, LA "HYDROLOGIC CHARACTERISTICS"

2


LEGEND

EXISTING CONDITIONS

∠ 2PPT

∠ 15PPT

CHANGE DUE TO PROJECT

∠ 2PPT

∠ 15PPT

9000 0 9000 18000

SCALE-FEET

URCE U.S. FISH AND WILDLIFE SERVICE, 1978 "WETLAND
ES IN THE MISSISSIPPI RIVER ACTIVE DELTA (1956-1978)"
AL COASTAL ECOSYSTEM TEAM, SLIDELL, LA AND BURK &
ATES, 1979, PLAQUEMINE PARISH, LA "HYDROLOGIC
TERISTICS"

2

BATON ROUGE TO THE GULF OF MEXICO, LA.

WATER QUALITY APPENDIX

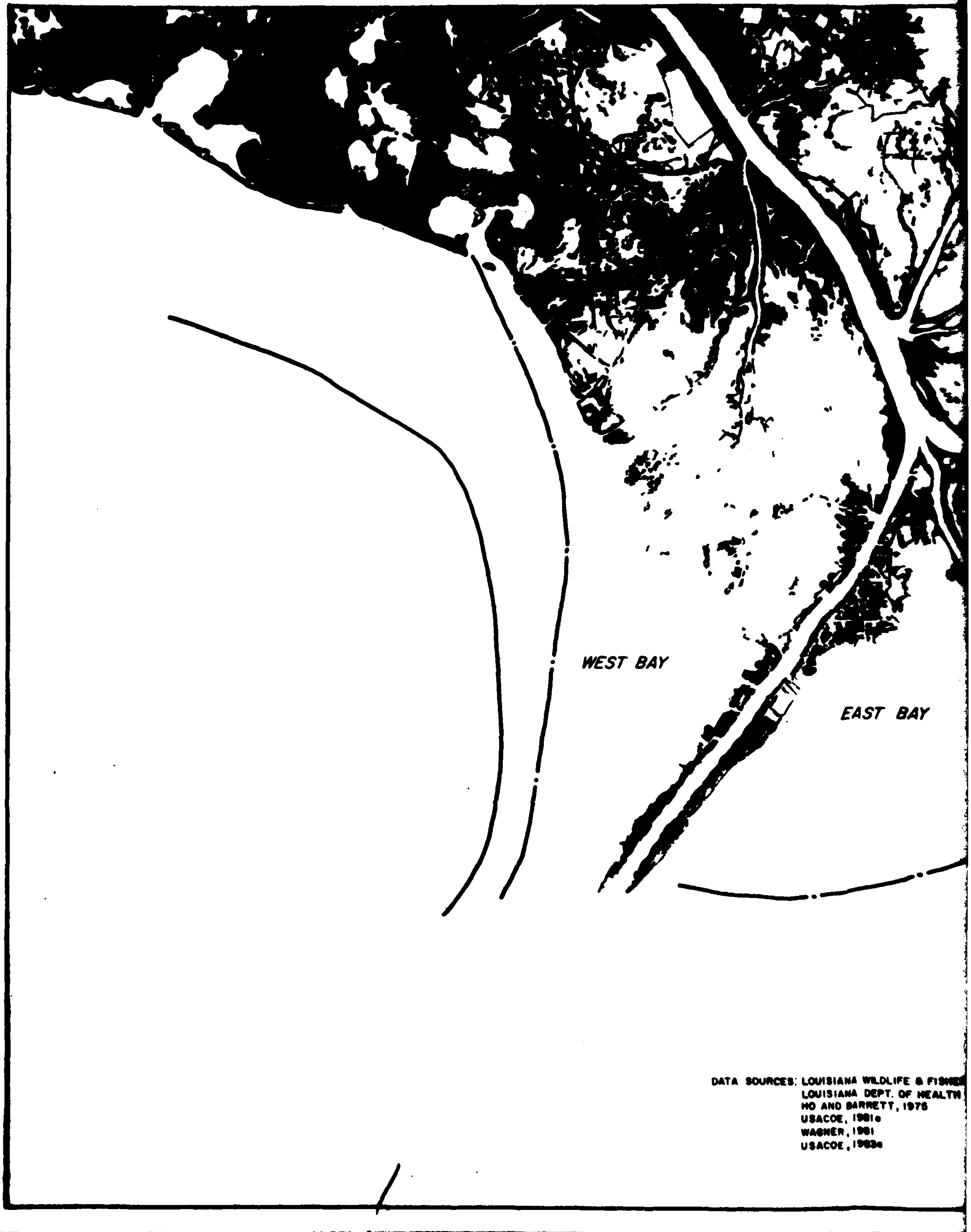
SUPPLEMENT NO. 2

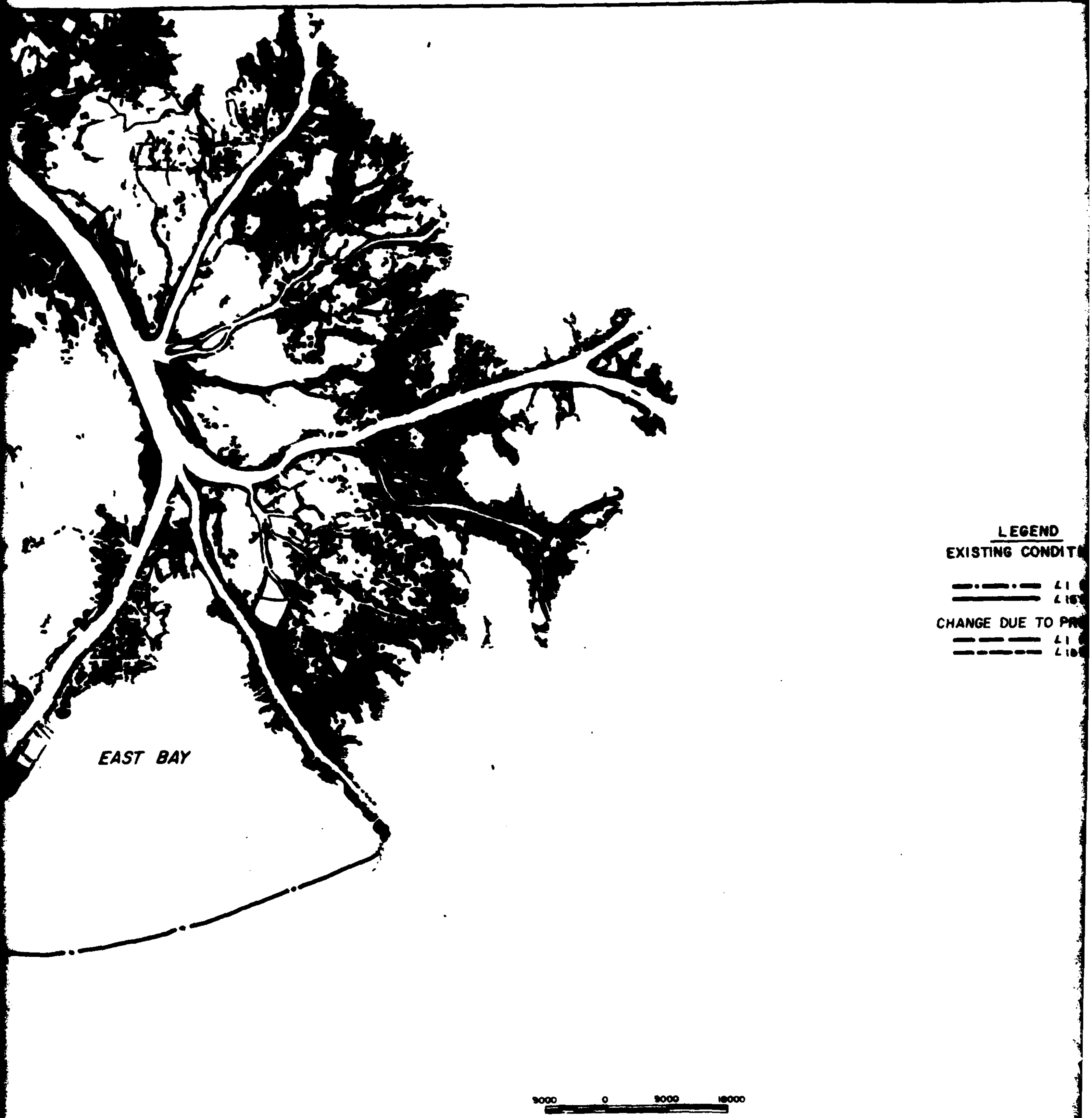
AVERAGE MEDIUM FLOW (350,000 CFS)
SALINITY DISTRIBUTION IN AND AROUND
THE ACTIVE MISSISSIPPI RIVER DELTA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

3

PLATE 4

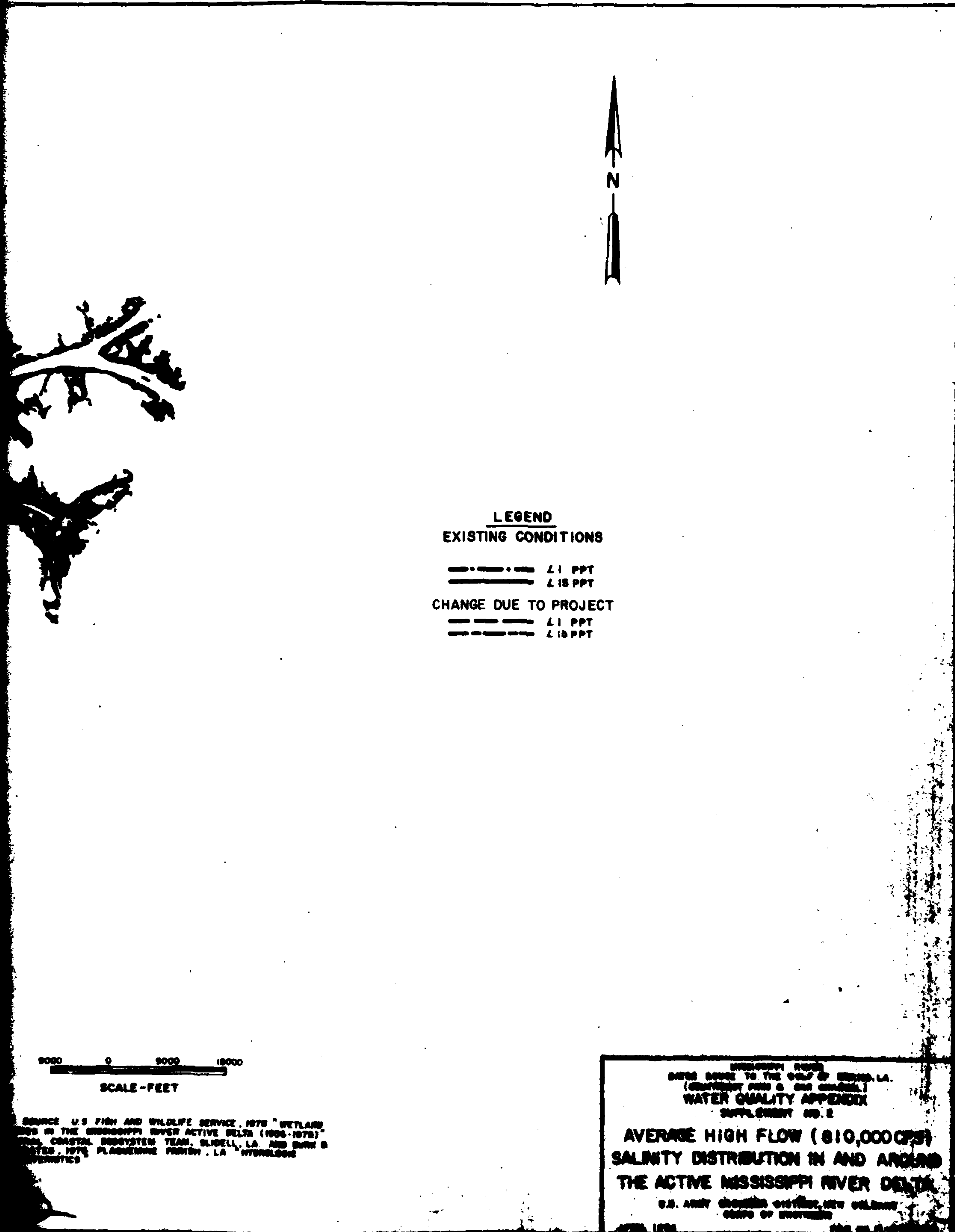

WEST BAY
EAST BAY
DATA SOURCES: LOUISIANA WILDLIFE & FISHE
LOUISIANA DEPT. OF HEALTH
HO AND BARRETT, 1978
USACOE, 1981a
WAGNER, 1981
USACOE, 1983a

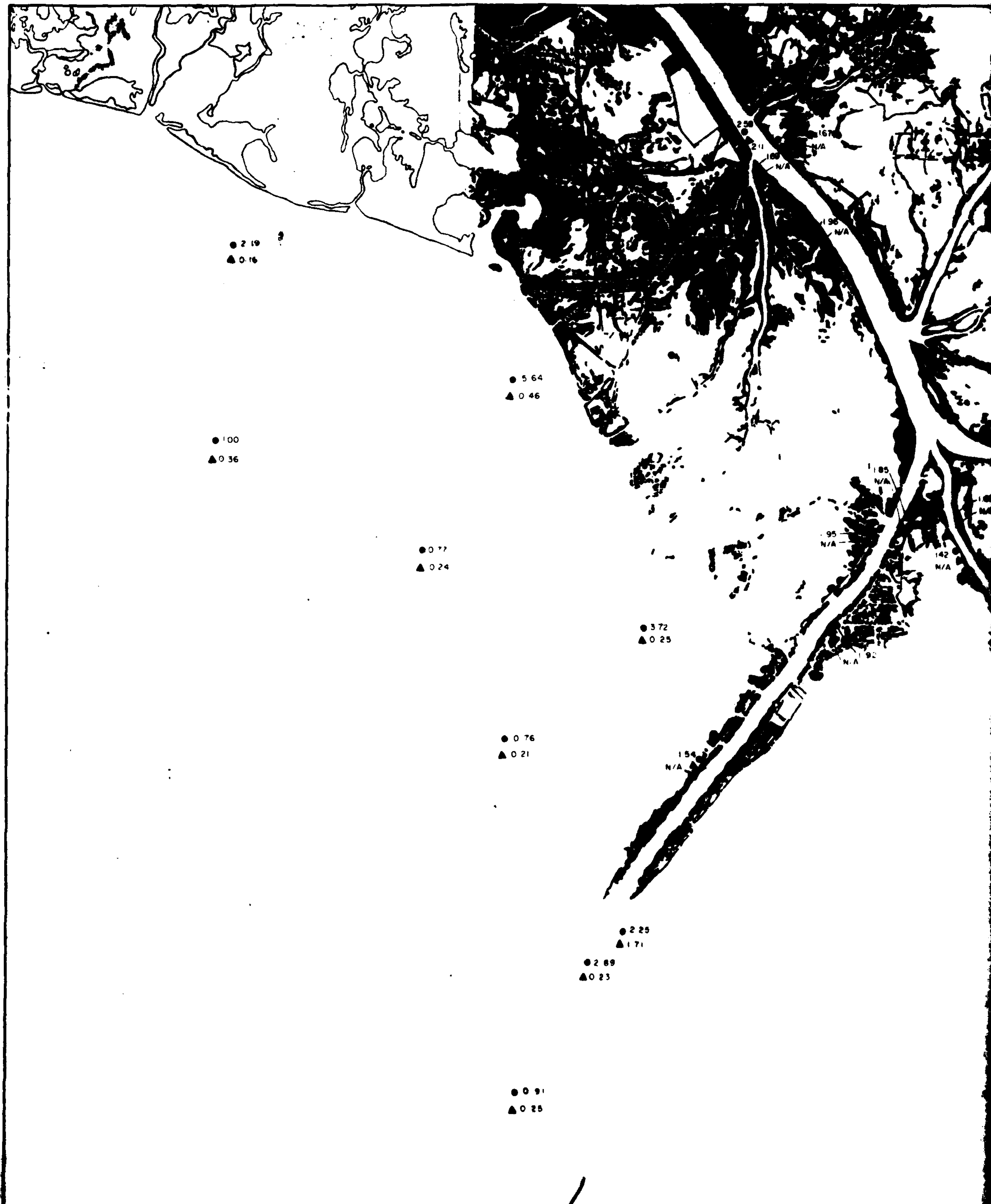



URCES: LOUISIANA WILDLIFE & FISHERIES COMMISSION, 1968-69
LOUISIANA DEPT. OF HEALTH & HUMAN RESOURCES 1972
HO AND BARRETT, 1975
USACOE, 1981a
WAGNER, 1981
USACOE, 1983a

MAP SOURCE U S FISH AND WILDLIFE SERVICE, 1978 "WETLAND CHANGES IN THE MISSISSIPPI RIVER ACTIVE DELTA (1956-1978)" NATIONAL COASTAL ECOSYSTEM TEAM, SLIDELL, LA AND BURK & ASSOCIATES, 1979 PLAQUEMINE PARISH, LA "HYDROLOGIC CHARACTERISTICS"

2


N
LEGEND
EXISTING CONDITIONS
∠ 1 PPT
∠ 15 PPT
CHANGE DUE TO PROJECT
∠ 1 PPT
∠ 15 PPT
9000 0 9000 18000
SCALE-FEET
WATER QUALITY APPENDIX
AVERAGE HIGH FLOW (810,000 CFS)
SALINITY DISTRIBUTION IN AND AROUND
THE ACTIVE MISSISSIPPI RIVER DELTA


2.19
0.16
5.64
0.46
1.00
0.36
0.77
0.24
3.72
0.25
0.76
0.21
2.25
1.71
2.89
0.23
0.91
0.25


9000 0 9000 18000

SCALE-FEET

MAP SOURCE U.S. FISH AND WILDLIFE SERVICE, 1978 "WETLAND CHANGES IN THE MISSISSIPPI RIVER ACTIVE DELTA (1956-1978)" NATIONAL COASTAL ECOSYSTEM TEAM, SLIDELL, LA. AND BURK & ASSOCIATES 1976 PLAQUEMINE PARISH, LA. "HYDROLOGIC CHARACTERISTICS"

DATA SOURCES

HO AND BARRETT, 1975 - NEARSHORE DATA

USGS, 1979, 1980, 1981 - RIVER DATA

USCOE, 1981b - OVERBANK DATA

LEGEND

● - TOTAL DISSOLVED NITROGEN CONCENTRATION (mg/l) DURING HIGH FLOW PERIODS (APRIL - MAY)

▲ - TOTAL DISSOLVED NITROGEN CONCENTRATION (mg/l) DURING LOW FLOW PERIODS (SEPT - OCT)

N/A NOT AVAILABLE

WATER QUALITY APPENDIX

SUPPLEMENT NO. 2

TOTAL DISSOLVED NITROGEN IN DELTA SURFACE WATERS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

PLATE 6

0.31
0.23
0.2
N/A
0.25
N/A
0.20
N/A
0.19
0.03
0.09
0.05
0.03
0.01
0.32
N/A
0.16
N/A
0.26
N/A
0.19
N/A
0.03
0.04
0.10
0.04
0.33
N/A
0.02
0.08
0.19
N/A
0.16
0.21
0.10
0.05
0.06
0.22


DATA SOURCES

HO AND BARRETT, 1975 - NEARSHORE DATA

USGS, 1979, 1980, 1981 - RIVER DATA

USCOE, 1981b - OVERBANK DATA

LEGEND

- ● TOTAL DISSOLVED PHOSPHORUS CONCENTRATION (mg/l) DURING HIGH FLOW PERIODS (APRIL - MAY)
- ▲ TOTAL DISSOLVED PHOSPHORUS CONCENTRATION (mg/l) DURING LOW FLOW PERIODS (SEPT. - OCT.)

N/A - NOT AVAILABLE

9000 0 9000 18000

SCALE - FEET

MAP SOURCE U.S. FISH AND WILDLIFE SERVICE, 1978 "WETLAND CHANGES IN THE MISSISSIPPI RIVER ACTIVE DELTA (1956-1978)" NATIONAL COASTAL ECOSYSTEM TEAM, SLIDELL, LA AND BURK & ASSOCIATES, 1975 PLAQUEMINE PARISH, LA "HYDROLOGIC CHARACTERISTICS"

2

[illegible]

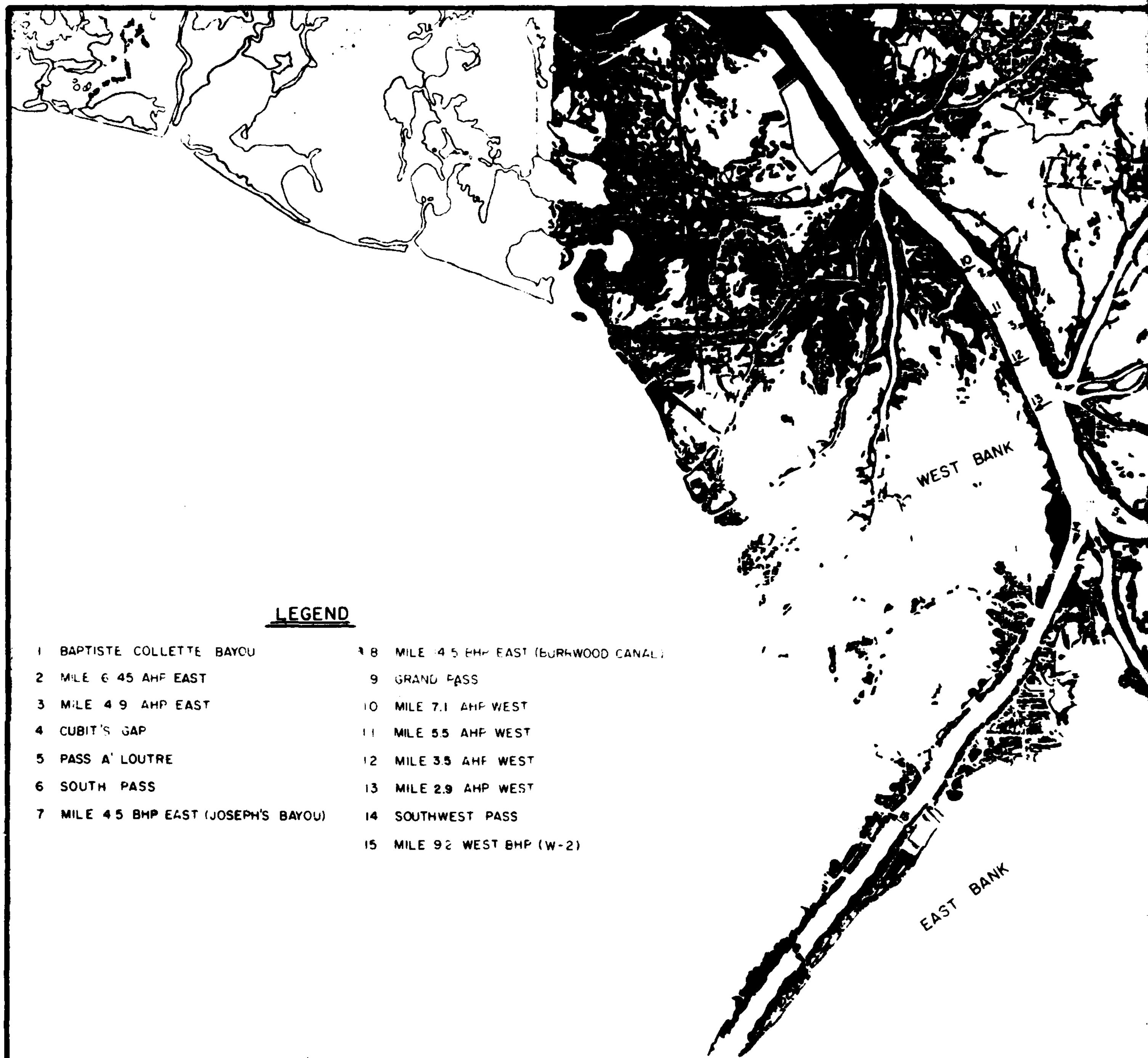
WATER QUALITY [illegible]

[illegible]

# TOTAL DISSOLVED PHOSPHORUS DELTA SURFACE WATERS

U.S. ARMY [illegible]

[illegible]


WEST BANK
EAST BANK
LEGEND
1 BAPTISTE COLLETTE BAYOU
2 MILE 6 45 AHP EAST
3 MILE 4 9 AHP EAST
4 CUBIT'S GAP
5 PASS A' LOUTRE
6 SOUTH PASS
7 MILE 4 5 BHP EAST (JOSEPH'S BAYOU)
8 MILE 4 5 BHP EAST (BURRWOOD CANAL)
9 GRAND PASS
10 MILE 7.1 AHP WEST
11 MILE 5.5 AHP WEST
12 MILE 3.5 AHP WEST
13 MILE 2.9 AHP WEST
14 SOUTHWEST PASS
15 MILE 9.2 WEST BHP (W-2)


MAP SOURCE U.S. FISH AND WILDLIFE SERVICE, 1978 "WETLAND CHANGES IN THE MISSISSIPPI RIVER ACTIVE DELTA (1956-1978)" NATIONAL COASTAL ECOSYSTEM TEAM, SLIDELL, LA AND BURK & ASSOCIATES, 1976 PLAQUEMINE PARISH, LA "HYDROLOGIC CHARACTERISTICS"

WATER QUALITY APPENDIX

PROPOSED OUTLETS IN LOWER MISSISSIPPI RIVER WITH SUPPLEMENT 2 PROJECT

2

# MISSISSIPPI RIVER, BATON ROUGE TO THE GULF, LOUISIANA, PROJECT

DRAFT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT II

APPENDIX F
SECTION 404 (b)(1) EVALUATION

APRIL, 1984

MISSISSIPPI RIVER, BATON ROUGE TO THE GULF, LOUISIANA
SECTION 404(b)(1) EVALUATION

INTRODUCTION

1. Project Description. The Mississippi River between the Gulf of Mexico and Baton Rouge, Louisiana, currently provides a navigational channel with a project authorized depth of 40 feet. This channel serves the ports of New Orleans and Baton Rouge, ranked first and sixth in United States tonnage during 1981. The New Orleans District, U.S. Army Corps of Engineers, maintains this channel by annual dredging. Since 1973, maintenance requirements in the reach between Venice, Louisiana, and the Gulf have increased and are projected to increase drastically in the future because of accelerating loss of riverbanks. To reduce these maintenance requirements and minimize dredging cost and risks to navigation, artificial banks and various training works would be required downstream of Venice. Essentially, these structures would restore the bank conditions of the river below Venice to their condition prior to the 1973 flood.

This evaluation concerns construction and maintenance of the features or aspects of the proposed work which would require disposal of dredged or fill material into riverine and wetland areas. Specifically, this evaluation addresses foreshore protection dikes, flotation-channel disposal areas, freshwater outlet channels, bank nourishment, and marsh creation. The project Environmental Impact Statement, Supplement II, should be consulted for expanded information on all topics.

2. Location. All work would take place downstream of Venice, Louisiana. The foreshore protection dikes and bank nourishment would be placed in the Mississippi River from mile 4.3 Above Head of Passes (AHP) to 11.2 AHP on the east bank and from mile 0.5 AHP to 10.6 AHP on the west bank. Along Southwest Pass, 10 miles of new foreshore protection

dikes and bank nourishment would be constructed on the west bank. On the east bank of Southwest Pass, 14.6 miles of new foreshore dikes and bank nourishment would be required. The existing jetties at Southwest Pass would be improved, inner bulkheads would be built, and dredged material placed between the bulkheads and jetties. Flotation channels would be required along all foreshore protection dikes for purposes of construction and maintenance. Disposal areas for material excavated from the flotation channels would be riverward of the flotation channels. Freshwater outlet structures would be constructed in the west bank AHP at miles 7.1, 5.5, 3.5, and 2.9. Existing outlets at miles 6.45 and 4.9 AHP would be stabilized. From 9,000 to 13,600 acres of marsh would be created in overbank areas south of Venice, Louisiana.

3. General Description. Structures, dimensions, elevations, and areas of direct impact of the proposed engineering features are listed in Table F-1.

4. Authority and Purpose. Congressional authority for the construction of the "Mississippi River, Baton Rouge to the Gulf, Louisiana," project is contained in the River and Harbor Act of 2 March 1945 (Public Law 14, 79th Congress, 1st Session). The Act authorizes construction in accordance with the plans recommended in the report of the Chief of Engineers printed in H.D. 215, 76th Congress, 1st Session. The purpose of this supplement is to delete and defer certain items of work included in Supplement No. 1 to the General Design Memorandum dated December 1962, and the LMNED-DG Letter Report dated 16 August 1974, subject "Mississippi River, Baton Rouge to the Gulf of Mexico--Completion of Project," and to provide for the accomplishment of additional work for which a present or possible future need has been determined.

TABLE F-1

404 ACTIONS (PLACEMENT OF DREDGED OR FILL MATERIAL INTO NAVIGABLE WATERS OR WETLANDS)

| Feature | Dimensions | Design Elevations | Impact |
|---|---|---|---|
| Foreshore Protection Dike | 90 ft. (wtd. ave.) bottom width, by 35 miles Venice to mile 18 BHP 1/ | +7.0 to +7.5 NGVD | 225 acres of river bottom would become dike. |
| Flotation Channel Disposal Area | 100 ft. wide by 35 miles | -2.0 to -15.0 NGVD | Two million cu. yds. excavated and disposed in river impacting 500 acres of river bottom |
| Fill Between Inner Bulk-Heads and Jetties 2/ | 900 ft. wide by 5.5 miles | +4.0 NGVD | 600 acres of water bottoms would become scrub/shrub |
| Freshwater Outlet Weirs | Six channels, five 100 ft. wide and one 700 ft wide | 0.0 NGVD | 25 acres |
| Bank Nourishment | Approx. 200 ft. on each side of river x 35 miles Venice to mile 18 BHP | +4.5 NGVD AHP 3/<br>+4.0 NGVD BHP | 1,250 acres of river bottoms would become scrub/shrub |
| Marsh Creation | Variable | +2.0 NGVD | 9,000-13,600 acres in open water |

1/ BHP = Below Head of Passes.
2/ Jetty stabilization is repair of currently serviceable structure.
3/ AHP = Above Head of Passes.

5. General Description of Dredged Material.

a. General Characteristics of Material. This project area is located within the active Mississippi River delta. Sediments consist of a variety of Holocene Age deltaic deposits. Borings indicate the presence of natural levee, marsh, interdistributary, intradelta, prodelta, bay-sound, and crevasse deposits. These deposits consist of varying amounts of silt, sand, clay, and mixtures of these materials. The Holocene material is underlain, at depths ranging from 600-800 feet, by Pleistocene Age deposits.

Maintenance dredging of the channel from Venice to the mouth of Southwest Pass involves mixtures of silts, clays, and sands which vary in location annually. Samples from disposal mounds west of mile 10 BHP Southwest Pass indicated 86% sand, 14% fines at upland elevations; 12-35% sand, 65-88% fines at intertidal elevations; and 2-6% sand, 94-98% fines at submerged elevations. Dredge disposal sediments sampled contained less than 5% organic matter.

b. Quantity of Materials. Dredged-material disposal would be associated with the flotation channel, bank nourishment, fill between jetties and inner bulkheads, and marsh creation aspects of the project. Estimated quantities are 2 million cubic yards, 62 million cubic yards, and 371 million cubic yards, respectively. All above quantities are based on a maintenance dredging requirement averaging 12.7 million cubic yards annually after project completion. Existing dredging requirements average 20 million cubic yards annually. Approximately 2.3 million cubic yards of rock and 2.2 million cubic yards of shell would be utilized in construction of the foreshore protection dikes. Construction of the weirs at the four new outlets would utilize a minor amount of fill.

c. Source of Materials. Most dredged material would be obtained from the 40-foot navigational channel. Additional material might be required to build the bank nourishment feature on schedule. Additional quantities would first be obtained by dredging the navigational channel to a maximum 55-foot depth where necessary. Such quantities might be required in any particular area along Southwest Pass. Approximately 6 million additional cubic yards would be required above Head of Passes. Between miles 3.5 to 6.0 and 8.0 to 10.0 AHP, borrow areas outside the navigational channel would also be required to provide 1.8 and 1.7 million cubic yards, respectively. Rock and shell material would be obtained from usual sources. Material from construction of the four new freshwater outlets would be utilized for bank nourishment.

6. Description of the Proposed Discharge Site.

a. Location. Plates 6 through 21 of the EIS designate the proposed disposal areas.

b. Size. Size of disposal areas is indicated in Table F-1.

c. Type of Site. Dredged material from flotation channels would be disposed into the river and carried away by natural river processes. Bank nourishment and fill adjacent to jetties would comprise upland fill into previously riverine environment. Marsh creation material would be disposed into open water at intertidal elevations. Foreshore protection dikes and outlet weirs would be placed in shallow riverine habitat.

d. Types of Habitat. Habitats impacted by disposal would include the shallow riverine environment and fresh areas. Deep river habitats would be minimally affected.

e. Timing and Duration of Discharge. Project construction would proceed during normal maintenance dredging periods and is estimated to be complete in 1992. Maintenance of bank nourishment elevations and continuing marsh creation would occur after that time through the end of project life in 2042.

7. Description of Disposal Method. The primary method of disposal would be by hydraulic dredge. Material would be pumped into the overbank, with marsh created as a by-product. In addition, material would be pumped into the river as bank nourishment. Bucket dredges would be used for construction of the flotation channels. The dikes and inner bulkheads would be built by off-loading barges with a crane.

FACTUAL DETERMINATIONS

1. Physical Substrate Determinations.

a. Substrate Elevation and Slope. Design elevations are listed in Table F-1. Generally, the project would return the river banks to their natural elevation prior to the 1973 flood.

b. Sediment Type. Disposal and fill materials would be comprised of adjacent channel sediments. Unconfined dredged material mounds would display an unnatural gradient of sands to fines due to pipeline disposal. No significant change in sediment types would be expected.

c. Dredged/Fill Material Movement. Riverine processes would distribute material disposed into the river. Marsh creation dredged fill would be subject to erosional forces until vegetated. Dredged material placed for bank nourishment and fill adjacent to jetties would be expected to remain in place.

d. Physical Effects on Benthos. Disposal would cause burial of existing benthic populations on 11,100 to 15,700 acres. The substantial benthic populations along existing river banks (Demas, 1983; Wells and Demas, 1979) and existing open-water overbank areas (El-Sayed and Rae, 1961) would be eliminated, especially by bank nourishment and marsh creation. Of these two habitats, the shallow riverine area would be the more significant because of its scarcity in the project area. On the other hand, construction of foreshore protection dikes and development of marsh would present significantly more opportunities for benthic populations to develop.

e. Actions Taken to Minimize Impacts. The bank nourishment feature has been designed at the minimum necessary dimensions to reduce impacts. Marsh creation, as a by-product of unconfined dredged material disposal, would expand critically needed habitat in the area.

2. Water Circulation, Fluctuation, and Salinity Determinations.

a. Water. Since the bank nourishment feature would affect river stages, and thereby influence the entire Mississippi River delta, the topics below address the project as a whole and its entire area of influence. Table F-2 compares existing and with project flow distribution from Venice to the Gulf. For a more complete discussion of effects described in this section, see EIS Appendix E, "Water Quality."

(1) Salinity. The east delta above Head of Passes would receive more water than it does now at all flows, and isohalines would move slightly Gulfward. Along Southwest Pass near East Bay, less water would exit than does at present, so existing isohalines would move up to 15,000 feet inward. At all flows, the west delta would receive less water than it does now, except for portions of Southwest Pass. However, impacts on isohalines would be slight because, at the time of greatest flow reduction, high gulf stages and tremendous freshwater outflow would

TABLE F-2

COMPARISON BETWEEN THE MISSISSIPPI RIVER EXISTING AND PROJECT FLOW DISTRIBUTION, VENICE TO THE GULF

| | East Bank Venice to HP 1/ | East Bank SW Pass | West Bank Venice to HP | West Bank SW Pass |
|---|---|---|---|---|
| Low flow(November) | | | | |
| Existing Overbank+ Outlets, cfs | 160,000 | 14,000 | 17,000 | 11,000 |
| Project, cfs | 162,000 | 6,000 | 15,000 | 8,000 |
| % Change with Project | + 1 | -57 | -12 | -27 |
| High flow(April) | | | | |
| Existing Overbank+ outlets, cfs | 457,000 | 55,000 | 130,000 | 36,000 |
| Project, cfs | 510,000 | 31,000 | 72,000 | 41,000 |
| % Change with Project | +12 | -44 | -45 | +14 |
| 12-month average flow | | | | |
| Existing overbank+ outlets, cfs | 270,000 | 26,000 | 49,000 | 19,000 |
| Project, cfs | 286,000 | 14,000 | 31,000 | 19,000 |
| % Change with Project | +6 | -46 | -37 | 0.0 |

1/ Head of Passes

tend to counteract each other. There would be a slight movement (up to 4,500 feet) inland of the 2 and 15 °/oo isohalines along the upper west bank of Southwest Pass. The effect of changes in flow distribution would be to make the marshes slightly less fresh along the upper portion of Southwest Pass on both its east and west sides.

(2) Water Chemistry. The average ambient pH values recorded within the project area during the water year 1981 ranged from 6.8 to 7.8 (USGS, 1981). Some of the physical and chemical changes which normally result from dredging activities are likely to affect the pH of the receiving waters (Canter et al., 1977). Factors such as increased turbidity, release of organic material, chemical leaching, and possible depressing of DO levels could contribute to a possible minor acidic shift in the pH of the water at the proposed dredging and disposal sites. USGS (1976-1978) studies indicate that only a very slight decrease in the ambient pH value occurred 100 yards downstream of actual lower Mississippi River dredging operations. These studies also show that there were insignificant changes in the levels of other chemical factors such as COD, hardness and dissolved sodium, calcium, and magnesium. The overall effect on water chemistry is expected to be negligible. Water quality should return to normal background conditions soon after disposal operations are complete.

(3) Clarity. A reduction in water clarity downstream of the disposal areas is expected as a result of increased turbidity levels which would occur during project construction. Reduced water clarity is expected to be localized and temporary, occurring at the time of disposal activities and returning to normal background conditions soon afterwards.

(4) Color. The proposed project construction would cause the ambient muddy-gray and brown colors to become slightly more intense. The expected discolorations beyond the normal background color

quality range of 0-60 platinum-cobalt units (USGS, 1978-1981) would be associated primarily with the increase in suspended organic matter because of dredged-material disposal and should follow the same general pattern as that associated with water clarity.

(5) Odor. Dredged-material disposal would not cause a water odor problem because the river sediment contains little organic matter for sulfide production, and because any potential odor-producing gases or chemicals released from the effluent would quickly disperse.

(6) Taste. No significant change in taste is expected. No intakes exist in the project area.

(7) Dissolved gas levels. Dissolved oxygen (DO) is the only important dissolved gas which could be affected by circulation changes caused by disposal. Reduction of overbank flows, resulting from bank nourishment, would not significantly reduce DO levels in overbank areas. The project would not affect DO levels in the waters of the Mississippi Bight in any measureable way because approximately the same amount of fresh water and nutrients would be entering that area from Southwest Pass and from distributary and outlet flow; although the exact distribution might vary from the present state. The area east of the delta would sustain higher levels (i.e., closer to saturation) at all river discharges because of the increase in volume of freshwater flowing out of the east delta distributaries.

(8) Nutrients. Nutrient loading to the east delta between Venice and Head of Passes would be increased because of increased flows (see Table F-2). In the east delta along Southwest Pass, nutrient loading would be decreased. This might be offset by creation of marsh along Southwest Pass which would contribute additional nutrients. Loading of nutrients to the west delta between Venice and Head of Passes would be decreased; however, few adverse impacts would be

expected. The west bank of Southwest Pass would experience essentially no reduction in nutrient loadings on an annual basis.

(9) Eutrophication. Normal flow rates in the river and tidal action in the overbank areas would prevent eutrophic conditions from occurring. Higher nutrient concentrations which might be experienced in some areas would not be expected to result in eutrophication.

b. Current Patterns and Circulation.

(1) Current Patterns and Flow. The construction of artificial river banks would result in the elevation of river stages between Venice and the Head of Passes and in the Southwest Pass below the Head of Passes. Computations predicting project conditions indicate that on the average more of the river flow at Venice would be passing through each of the six major distributaries as a result of project completion. This flow increase to the passes is the result of a similar reduction of overbank flow to the west delta between Venice and Head of Passes and closure of outlets along Southwest Pass. The average deviation from the total existing flows to the wetlands in the four study units is shown in Table F-2. Increasing distributary outflow in one area of the delta while decreasing or eliminating outlet or overbank flow in another area might bring about localized changes in circulation of inshore waters, but would not affect major circulation patterns in nearshore or offshore waters.

(2) Velocity. Increased river stages and the slight constriction of the river by the foreshore protection dikes would result in slightly higher flow velocities. This increase would reduce shoaling and thereby decrease maintenance dredging requirements from an average 20 million cubic yards per year to 12.7 million cubic yards per year after project completion.

(3) Stratification. No significant changes in the water column stratification would occur from disposal operations (Wells, 1980).

(4) Hydrologic Regime. No significant impacts on the normal hydrologic regime would occur.

c. Normal Water Level Fluctuations. In accordance with project design, river stages would rise slightly. No adverse effects on navigation would be expected.

d. Salinity Gradients. Changes in the flow distribution would affect salinities as described previously in Section 2.a.(1). Generally, effects would be slight.

e. Actions Taken to Minimize Impacts. The area above Head of Passes on the west side would have received the greatest adverse effects of the project-induced change in flow distribution under the original design. However, the addition of four freshwater outlet channels along this reach insures outlet flow throughout the year. This design change minimizes impacts to the area.

3. Suspended Particulate/Turbidity Determinations.

a. Expected Changes in Suspended Particulates and Turbidity Levels in the Vicinity of Disposal Site. During hydraulic dredging, the turbidity plume generally becomes indistinguishable within 2,000 feet of a river discharge site and the turbidity concentrations are within ambient range at about 400 feet from the discharge pipe (Stern and Stickle, 1978). Duration and extent of turbidity increases should be minor because of the extensive dilution capacity of the river. Disposal in the overbank would create temporarily high suspended particulate and turbidity levels in the vicinity of disposal activities.

b. Effect on Chemical and Physical Properties of the Water Column.

(1) Light penetration. Light penetration would be temporarily affected in overbank areas in connection with turbidity increases. Effects on the water column of the river would be minimal.

(2) Dissolved oxygen. The DO levels in inland delta marsh waters are not expected to decrease to critical levels for aquatic life (less than 5 mg/l $O_2$) in any area because of turbidity related to disposal.

(3) Toxic metals and organics. The following sections summarize the results of the testing programs utilized to evaluate possible pollutant impacts. For a more detailed discussion of the results, see EIS Appendix E.

Historical elutriate data indicate cadmium, PCB, and chlordane to be the major problem pollutants which would exceed freshwater and marine chronic criteria. Dieldrin, DDT, lindane, arsenic, chromium, copper, lead, nickel, mercury, and zinc also have been detected with regularity in these elutriates. However, the concentrations of these contaminants in elutriates is generally less than, or about the same as, ambient river water. For many of these trace metals, elutriation might actually reduce the ambient river-water concentration because of adsorption processes.

Because bank nourishment and fill between the jetties and bulkheads would involve the creation of 2,100 acres of scrub-shrub upland, the standard elutriate test was modified to simulate leachate coming off new and old upland disposal areas (see Table F-3). The results of these limited tests indicate that pollutants of concern might leach in varying degrees depending on the age of the upland area, and might continue to

Table F-3

MEAN CONCENTRATION IN ELUTRIATE FOR VARIOUS TESTS
(3 SAMPLES PER TEST)

| | Test 1 1/ | Test 2/ | Test 3/ | EPA Freshwater Aquatic Life Criteria (chronic) |
|---|---|---|---|---|
| PCB ug/l | 0.83 | 1.4 | 0.7 | 0.14 |
| DDE ug/l | 0 0.003 | 0 | 0.0010 | |
| Chlordane ug/l | 0.031 | 0 | 0.02 | 0.0037 |
| Cadmium ug/l | 9.1 2.8 | 5.4 | 0.025 4/ | |

1/ Test 1 - standard elutriate (wet channel sediments).

2/ Test 2 - modified elutriate (distilled water and air-dried channel sediments).

3/ Test 3 - modified elutriate (oxidized sediments from existing upland disposal area).

4/ Criterion - is hardness dependent, $CaCO_3$ concentration of 146 mg/l assumed.

pose a threat for several years. When an area becomes oxidized as it ages, more cadmium and chlordane might leach out while less DDE and PCB might be released. Test 1 simulates immediate, short-term chemical releases possible during the hydraulic dredging process. It should be noted that all mean concentrations in Table F-3 above zero exceed EPA chronic toxicity criteria for freshwater aquatic organisms.

Based on utilization of a dragline, disposal in a similar reduced environment, and the dilution potential of the Mississippi River, the potential release of contaminants associated with disposal from construction of flotation canals should not adversely impact the ambient water quality of the project area, nor should bioaccumulation potentials be increased.

Utilization of barge-mounted draglines, the dilution potential of the Mississippi River, and the upland character of the material to be excavated would make contaminant releases associated with the freshwater outlet features minimal.

Immediate water quality impacts resulting from bank nourishment would be associated primarily with effluents. Effluents returning to the river would be rapidly diluted, thereby resulting in essentially no alteration of river water quality. Effluents moving away from the river would be expected to temporarily degrade the estuarine water bodies. However, sediment particles in the effluent would settle out and the physical forces (tidal regimes, wind, wave action, and currents of the bay and estuarine water) would result in the reduction of contaminant concentrations in the receiving waters through mixing and dilution.

Eventual impacts of bank nourishment and marsh creation would include long-term contaminant releases associated with leaching. Movement of contaminants from these disposal areas is expected to be mainly toward the river where they would be diluted. Contaminants

leaching into the newly created marshes would not be expected to mobilize significantly. Some dilution and flushing of these contaminants is expected at the surface of these marshes because of tidal flooding and rain-related runoff. In marsh areas not subject to regular inundation by tidal waters, contaminants would be expected to influence the interstitial water quality. Alteration of interstitial water quality could be such that EPA freshwater and saltwater chronic criteria for PCB, DDE, and cadmium might be exceeded. These pollutants could be present in sufficient concentrations to pose possible short-term toxicity problems for the biota associated with the marsh. Contaminants shown to be released are all potentially bioaccumulative in the plants and benthic biota which would become established in these areas. Bioconcentration of these contaminants by the flora and fauna would serve to keep contaminants in areas of the marsh which are not regularly flushed. The nearly annual flushing of river water throughout the overbank, however, would eventually dilute elevated levels to near ambient.

The freshwater outlet structures planned for the west bank above Head of Passes would play an important role in maintaining sufficient flushing in that area.

(4) Pathogens. There are no water intakes downstream of the disposal area; therefore, any slight potential for increase of pathogens is of no concern.

(5) Esthetics. The turbidity caused by disposal would temporarily decrease the esthetics of the area.

c. Effect on Biota.

(1) Primary production/photosynthesis. Phytoplanktonic production in both riverine and overbank disposal areas would be

temporarily inhibited by disposal of dredged material. However, significant increases of macrophytic production in created marshes would far surpass the temporary losses.

(2) Suspension/filter feeders. Suspension feeding and/or filter-feeding organisms living in the primary impact zones downstream of the disposal areas would be expected to suffer some mortality and secondary effects as a result of the disposal operations. These organisms could experience a reduction in pumping rate and clogging of the filtering apparatus because of increased concentrations of suspended solids, but these effects would be temporary if turbidity levels do not remain elevated for long periods.

Eggs, larval, and juvenile forms of nektonic and benthic organisms are more sensitive to relatively minor increases in suspended particulates than are the adults. These organisms might be adversely affected by high turbidity levels within the immediate vicinity of the disposal site. Repopulation by any impacted suspension and/or filter feeding species would be expected to commence shortly after cessation of disposal activity.

(3) Sight feeders. Sight feeders, mostly nektonic forms like fish, would not be adversely affected by increased turbidity, because they could easily migrate out of the immediate vicinity of the disposal sites until dredging activity ceased. Some of the main channel fish like sturgeon, gar, paddlefish, and buffalo are adapted to the normal low visibility and would not be disturbed by slightly higher turbidity levels.

d. Actions Taken to Minimize Impacts. No specific actions to minimize impacts to biota because of turbidity and suspended particulates could be incorporated. Most organisms inhabiting the Mississippi River and adjacent coastal environments are tolerant of high turbidity.

4. Contaminant Determinations.

Historical data collected between 1975 and 1982 have shown that Mississippi River sediments and marsh sediments between Venice and the Gulf of Mexico are very uniform in concentrations of most contaminants. Studies of the vegetation and biomass production on a recently created dredged-sediment salt marsh and a naturally accreted salt marsh in the lower delta area, indicate the salt marshes created on dredged material support significantly greater vegetative growth and biomass production than the natural marsh (USACE, 1982). Based on these results, it appears that the levels of individual toxic contaminants present in the lower Mississippi River dredged sediments are not high enough to adversely affect initial plant growth. Uptake studies suggest lack of any cumulative adverse effects of contaminants on marsh plants established on dredged sediments, although some PCB and mercury were bioaccumulated by oystergrass grown on dredged material. For more details, see EIS Appendix E.

The results of bioassays conducted on dredged river sediments collected from various points in the lower delta did not indicate significantly higher mortality of test organisms in the liquid, suspended solid, and solid phase medium compared to the same from the disposal site. The percent mortality in the reference as well as dredged sediment medium was generally below 10%. This suggests no short-term acute toxicity effects of possible contaminants in dredged material on the aquatic or benthic organisms.

The benthic and filter feeding organisms would be exposed to some contaminants in interstitial water and might incur long-term, low-level accumulation. A comparison of the worst-case contaminant levels in the dredged marsh and naturally accreted marsh sediment interstitial water indicates that PCB and cadmium concentrations exceeded EPA chronic criteria for saltwater aquatic species (U.S. EPA, 1980). However,

comparison of data indicates that the naturally accreted marsh sediment interstitial water PCB concentration was higher than that of the dredged marsh sediment interstitial water. Therefore, the potential chronic adverse biological impacts of PCB would not be any greater on dredged marsh than on natural marsh. The cadmium level of dredged sediment appears to present a slight potential for chronic adverse effects on benthic populations after marsh creation.

In an effort to gain additional perspective, surveys of data from natural marshes in other areas of the United States were reviewed. Results indicate both natural and dredged marshes in the project area compare favorably with marshes in other areas (see EIS Appendix E for more details).

5. Aquatic Ecosystem and Organism Determinations.

a. Plankton Effects. Phytoplankton productivity would not be impacted, as discussed in Section 3.c.(1). The natural flow rate of the river would prevent any algal blooms from occurring because of nutrient release from the dredged effluent. Zooplankton productivity would decrease slightly because of the abrasive and clogging action of the fine, suspended sediments transported downstream from the discharge points. Normal plankton productivity would resume when dredged-material disposal ceases.

Neither phyto- nor zooplankton would be expected to bioaccumulate contaminants from the dredged effluent because the elutriates indicated no significant potential contaminant release in bioavailable forms. If a contaminant is released from dredged river sediment, it would be instantaneously diluted upon discharge.

b. Benthos Effects. Bottom areas immediately downstream from the sites might be silted over temporarily during the dredging

operation; this might affect molluscs temporarily. In the overbank areas designated for marsh creation, existing shallow-water populations would be replaced by marsh communities. Significant changes would, therefore, occur because marsh communities are much more diverse and productive.

c. Nekton Effects. Aquatic areas affected by increased turbidity and undesirable water quality resulting from disposal operations would be avoided by fish populations. With the establishment of new marshes, fish populations would be expected to return in greater numbers with increased diversity.

d. Aquatic Food Web Effects. Effects on riverine food webs would be minimal. New marshes, on the other hand, should contribute to increased productivity and diversity, thereby benefiting the entire food web in the area. The potential for bioaccumulation of contaminants in this food web would increase.

e. Special Aquatic Site Effects.

(1) Sanctuaries and Refuges. Delta National Wildlife Refuge and the Pass a Loutre Waterfowl Management Area would be impacted both by alteration of flows and disposal of dredged material for the purpose of marsh creation. The U.S. Fish and Wildlife Service and the Louisiana Department of Wildlife Fisheries consider these impacts to be positive.

(2) Wetlands. No existing marshes would be buried. New marshes would be built from dredged material totalling up to 13,600 acres by the end of the project life in 2042.

(3) Mud Flats. Not applicable.

(4) Vegetated Shallows. Not applicable.

(5) Riffle and Pool Complexes. Not applicable.

f. Threatened and Endangered Species. No endangered or threatened species or their critical habitat are expected to be impacted by this project.

g. Other Wildlife. Migratory birds are expected to be beneficially impacted by the creation of new marshes.

h. Actions Taken to Minimize Impacts. The creation of extensive acreages of new marsh resulting from the unconfined disposal of dredged material is an environmental benefit outweighing the potential adverse impacts of the project.

6. Proposed Disposal or Construction Site Determinations.

a. Mixing Zone Determination. As discussed previously in Section 3.b.(3), elutriate analyses of similar bed sediments indicated that PCB, DDE, and cadmium exhibited the potential for release from dredged sediments during disposal. Elevated levels would be immediately reduced to ambient levels upon mixing with river or coastal waters.

b. Determination of Compliance With Applicable Water Quality Standards. The State of Louisiana has designated the Mississippi River from the Huey P. Long Bridge to Head of Passes as suitable for secondary contact recreation, propagation of fish and wildlife, and domestic raw water supply (LSCC, 1977). No contraventions of these standards would be expected as a result of project construction and the proposed disposal of dredged material. The EPA has adopted criteria for freshwater and saltwater aquatic life which have not been accepted as regulatory in Louisiana; however, they have been used in this evaluation

as a way to judge potential impacts. See Sections 3.c.(3) for discussion.

c. Potential Effects on Human Use Characteristics.

(1) Municipal and private water supply. There are no municipal river water intakes in the vicinity of the project disposal areas.

(2) Recreational and commercial fisheries. With a slight overall increase in river discharge to the east delta above Head of Passes and to East Bay, freshwater and estuarine fish and shellfish production would be expected to increase because of the additional sediment-laden and nutrient-rich river water which would aid in natural marsh accretion.

Increases in saltwater intrusion in the marshes fringing the west side of East Bay because of decreased overbank flow from Southwest Pass should not have significant impact on fishery resources and might benefit nursery grounds which might, at present, be too fresh to support many estuarine fishes.

An average annual decrease of river flow to the west delta between Venice and Head of Passes would have some adverse effect on fish productivity which is dependent on the natural marshes of the west delta. However, this effect is expected to be localized and relatively minor because few marshes are associated with the overflow areas which would be cut off as a result of the project. Most of the marshes of the west delta are associated with Grand/Tiger Pass, and average annual river flow to this distributary would increase slightly.

The above potential adverse impacts on fisheries resources would be more than offset by marsh creation from maintenance dredging along the

Mississippi River and Southwest Pass between Venice and the Gulf. Up to 13,600 acres of marsh would be created in the overbank area in this reach during the 50-year project life. Based on current commercial fish harvest and value data (USACE, 1981), this marsh creation effort would increase the annual fish harvest by an estimated 8.6 million pounds with a value of approximately $937,000.

(3). Water-related recreation. No significant effects.

(4) Esthetics. Tugboats, crewboats, cargo ships, and fishing vessels are the primary users of this otherwise uninhabited area. Dredging operations are common. No significant degradation of esthetics would be expected; however, the rock dikes would present an austere appearance. Creation of thousands of acres of new marsh would be expected to enhance the area.

(5) National Park and Historical Monuments, National Seashores Wilderness Areas, Research Sites, and Similar Preserves. The Delta National Wildife Refuge and Pass a Loutre Waterfowl Management Area would both be affected by project construction, but not in a significantly adverse manner. Both areas would experience an increase in water volume passing through them.

g. Determination of Cumulative Effects on the Aquatic Ecosystems. Significant changes because of the altered flow distribution, caused primarily by the bank nourishment feature, should be incurred throughout the Mississippi River delta. Though small in degree, the changes in flow volume, salinity, nutrients, and perhaps temperature, could initiate a subtle and localized change of plant species distribution. This change would be significant only when compared to the future without the project. The addition of 9,000-13,600 acres of new marsh would be a significant positive impact on ecosystems and fisheries dependent on marshes.

h. <u>Determination of Secondary Cumulative Effects on the Aquatic System.</u> Perhaps the greatest incidental change resulting from the project would be the increase in flow volume and rate through Southwest Pass. This increase would cause a wider gyre of river water influence in the Gulf of Mexico. Suspended sediment, nutrients, salinities, and temperatures would be significant parameters affected within the gyre. At worst, reduction of approximately 1°C in spring could reduce growth rates of juveniles slightly and temporarily. At best, the increased nutrient supply could further stimulate productivity at all trophic levels and result in higher fishery yields in the area between Southwest Pass and Texas.

FINDINGS OF COMPLIANCE WITH THE RESTRICTIONS ON DISCHARGE

1. No significant adaptions of the guidelines were necessary for this evaluation.

2. The only alternative to the proposed action would be to allow the river banks to continue to degrade, thereby incurring accelerating maintenance dredging requirements in the channel. This approach would result in greater risks to navigation each year until, eventually, the authorized channel could not be maintained. For this reason, this no-action alternative was rejected.

3. No significant contravention of Louisiana Water Quality Standards would be expected. Section 307 (a)(1) of the Clean Water Act is not regulatory in Louisiana.

4. No endangered or threatened species or their critical habitat would be significantly impacted by the project. There are no marine sanctuaries in the area.

5. Significant adverse effects on human health and welfare would not be expected. Effects on municipal and private water supplies, recreation and commercial fisheries, plankton, fish, shellfish, wildlife, and special aquatic sites have been considered. Impacts which would be expected have been detailed in the body of this evaluation. No significant adverse effects on life stages of aquatic life and wildlife dependent on the aquatic ecosystem would be expected. The potential for bioaccumulation of contaminants in the food web would increase as a result of marsh creation. Analysis of extensive data, however, indicates that the increased risk would not outweigh the benefits of marsh creation. No significant adverse effects on aquatic ecosystem diversity, productivity, and stability would be expected. No significant adverse effects on recreational, esthetic, and economic values would be expected.

6. Appropriate steps that would be taken to minimize potential impacts on the aquatic ecosystem have been discussed in applicable sections of this evaluation.

7. On the basis of the guidelines, the proposed disposal sites for the discharge of dredged material are specified as complying with the requirements of the guidelines with the inclusion of appropriate and practical conditions to minimize pollution and adverse effects on the affected aquatic ecosystem.

Date

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MISSISSIPPI RIVER, BATON ROUGE TO THE GULF,
LOUISIANA, PROJECT

DRAFT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT II

APPENDIX G
CONSISTENCY DETERMINATION:
LOUISIANA COASTAL RESOURCES PROGRAM

APRIL, 1984

APPENDIX G

CONSISTENCY DETERMINATION

LOUISIANA COASTAL RESOURCES PROGRAM

## INTRODUCTION

Section 307 of the Coastal Zone Management Act of 1972, 16 U.S.C. 1451 et. seq., requires that "each Federal agency conducting or supporting activities directly affecting the coastal zone shall conduct or support those activities in a manner which is, to the maximum extent practicable, consistent with approved state management programs." In accordance with Section 307, a consistency determination has been made for the recommended project. The recommended project features are described in EIS Section 4.1., "Recommended Project." Coastal Use Guidelines were written in order to implement the policies and goals of the Louisiana Coastal Resources Program, and serve as a set of performance standards for evaluating projects. Compliance with the Louisiana Coastal Resources Program, and therefore, Section 307, requires compliance with applicable Coastal Use Guidelines. This appendix is organized into two sections: "Coastal Use Guidelines" which displays each applicable guideline and the associated response and "Consistency Determination" which contains a discussion of the consistency of the recommended project with the Coastal Use Guidelines.

## COASTAL USE GUIDELINES

The following Coastal Use Guidelines were prepared to implement the policies and goals of the Louisiana Coastal Resources Program. The relationship of the recommended project to each guideline is displayed within this section.

### 1. GUIDELINES APPLICABLE TO ALL USES

Guideline 1.1: The guidelines must be read in their entirety. Any proposed use may be subject to the requirement of more than one guideline or section of guidelines and all applicable guidelines must be complied with.

Response 1.1: Acknowledged.

Guideline 1.2: Conformance with applicable water and air quality laws, standards, and regulations, and with those other laws, standards, and regulations which have been incorporated into the coastal resources program shall be deemed in conformance with the program except to the extent that these guidelines would impose additional requirements.

Response 1.2: Acknowledged.

Guideline 1.3: The guidelines include both general provisions applicable to all uses and specific provisions applicable only to certain types of uses. The general guidelines apply in all situations. The specific guidelines apply only to the situations they address. Specific and general guidelines should be interpreted to be consistent with each other. In the event there is an inconsistency, the specific should prevail.

Response 1.3: Acknowledged.

Guideline 1.4: These guidelines are not intended to nor shall they be interpreted so as to result in an involuntary acquisition or taking of property.

Response 1.4: Acknowledged.

Guideline 1.5: No use or activity shall be carried out or conducted in such a manner as to constitute a violation of the terms of a grant or donation of any lands or water bottoms to the state or any subdivision thereof. Revocations of such grants and donations shall be avoided.

Response 1.5: Acknowledged.

Guideline 1.6: Information regarding the following general factors shall be utilized by the permitting authority in evaluating whether the proposed use is in compliance with the guidelines.

Guideline 1.6(a): Type, nature, and location of use.

Guideline 1.6(b): Elevation, soil and water conditions, and flood and storm hazard characteristics of site.

Guideline 1.6(c): Techniques and materials used in construction, operation, and maintenance of use.

Guideline 1.6(d): Existing drainage patterns and water regimes of surrounding area including flow, circulation, quality and salinity; and impacts on them.

Guideline 1.6(e): Availability of feasible alternative sites or methods for implementing the use.

Guideline 1.6(f): Designation of the area for certain uses as part of a local program.

Guideline 1.6(g): Economic need for use and extent of impacts of use on economy of locality.

Guideline 1.6(h): Extent of resulting public and private benefits.

Guideline 1.6(i): Extent of coastal water dependency of the use.

Guideline 1.6(j): Existence of necessary infrastructure to support the use and public costs resulting from use.

Guideline 1.6(k): Extent of impacts on existing and traditional uses of the area and on future uses for which the area is suited.

Guideline 1.6(l): Proximity to and extent of impacts on important natural features such as beaches, barrier islands, tidal passes, wildlife and aquatic habitats, and forest lands.

Guideline 1.6(m): The extent which regional, state, and national interests are served including the national interest in resources and the siting of facilities in the coastal zones as identified in the coastal resources program.

Guideline 1.6(n): Proximity to, and extent of impacts on, special areas, particular areas, or other areas of particular concern of the state program or local programs.

Guideline. 1.6(o): Likelihood of, and extent of impacts of, resulting secondary impacts and cumulative impacts.

Guideline 1.6(p): Proximity to and extent of impacts on public lands or works, or historic, recreational, or cultural resources.

Guideline 1.6(q): Extent of impacts on navigation, fishing, public access, and recreational opportunities.

Guideline 1.6(r): Extent of compatibility with natural and cultural setting.

Guideline 1.6(s): Extent of long-term benefits or adverse impacts.

Response 1.6: The listed general factors were considered in the preparation of the EIS of which this appendix is a part. This EIS contains a full evaluation of the relationship of these factors to the recommended project.

Guideline 1.7: It is the policy of the coastal resources program to avoid the following adverse impacts. To this end, all uses and activities shall be planned, sited, designed, constructed, operated, and maintained to avoid to the maximum extent practicable significant:

Guideline 1.7(a): Reduction in the natural supply of sediment and nutrients to the coastal system by alterations of freshwater flow.

Response 1.7(a): The recommended project features would alter the existing flow distribution in order to accomplish the project objective of reducing maintenance dredging costs. However, by containing the overbank flow which currently escapes the river, the stages of the major distributaries and outlets would increase, sending additional water-borne

sediment and nutrients into the outlying areas of the delta. In addition, four new outlets would be built along the west bank of the Mississippi River above Head of Passes to supply 50 percent of the existing flow into that specific area during critical low-flow months. Unconfined disposal of hydraulically dredged material would add between 9,000 and 13,600 acres of marsh to the overbank areas. Therefore, it is expected that the overall reductions in sediment and nutrients supplied to the overbank areas would be localized and of insignificant magnitude.

<u>Guideline 1.7(b)</u>: Adverse economic impacts on the locality of the use and affected governmental bodies.

<u>Response 1.7(b)</u>: As discussed in EIS Seciton 6.24, "Plan Economics," the project would provide significant economic benefits to the locality of use. Benefit/cost ratios of 27.3 to 1 or 13.4 to 1 are projected depending on the interest rate used in the analysis.

<u>Guideline 1.7(c)</u>: Detrimental discharges of inorganic nutrient compounds into coastal waters.

<u>Response 1.7(c)</u>: Inorganic nutrient compounds would be released during dredged-material disposal operations; however, no sustained detrimental effects would be expected. Discharges into the river would be immediately diluted to ambient levels.

<u>Guideline 1.7(d)</u>: Alterations in the natural concentration of oxygen in coastal waters.

<u>Response 1.7(d)</u>: Oxygen would not be expected to become a limiting factor at any time within the project area.

Guideline 1.7(e): Destruction or adverse alterations of streams, wetlands, tidal passes, inshore waters and water bottoms, beaches, dunes, barrier islands, and other natural biologically valuable areas or protective coastal features.

Response 1.7(e): The project would result in the elimination of 3,000 acres of Southwest Pass waters and water bottoms and the temporary disturbance, by dredging, of 1,000 acres of Southwest Pass and Mississippi River waters and water bottoms below Venice. Marsh creation would result in the loss of between 9,000 and 13,600 acres of estuarine water bodies adjacent to Southwest Pass and the Mississippi River below Venice.

Guideline 1.7(f): Adverse disruption of existing social patterns.

Response 1.7(f): The project is expected to enchance existing social patterns, as discussed in EIS Section 6.5, "Community Cohesion."

Guideline 1.7(g): Alterations of the natural temperature regime of coastal waters.

Response 1.7(g): Spring temperatures in overbank areas with greater river influence could remain approximately 1°C colder than normal for an estimated two- to three-week period. In areas of lesser river influence, spring temperatures might warm earlier than usual. Neither of these changes would be noticable since normal temperature fluctuations would be more significant. Temperature changes during other seasons would be minimal.

Guideline 1.7(h): Detrimental changes in existing salinity regimes.

Response 1.7(h): Limited saltwater intrusion would occur along the east side of Southwest Pass. Addition of slight amounts to water to the east side of the delta would reduce saltwater intrusion. See Appendix E, "Water Quality," for a full discussion (Plates 3, 4, and 5).

Guideline 1.7.(i): Detrimental changes in littoral and sediment transport processes.

Response 1.7(i): The project would cause increased flows in all major passes with decreased flow over the west bank. Increased land-building and marsh-accretion rates would be expected along the shallow passes. Marsh creation with dredged material would offset sediment loss to the west overbank. Therefore, the net effect of project-induced changes to littoral and sediment transport processes would be positive.

Guideline 1.7(j): Adverse effects of cumulative impacts.

Response 1.7(j): All anticipated work within Southwest Pass and the Mississippi River below Venice for the purpose of maintaining the existing 40-foot channel has been included in this project EIS. This was done to ensure that the cumulative impacts of this work would be addressed.

Guideline 1.7(k): Detrimental discharges of suspended solids into coastal waters, including turbidity resulting from dredging.

Response 1.7(k): Suspended solid discharges would occur in all disposal areas. These localized, temporary releases would not adversely affect resident species for significant periods of time. Native species have adapted to naturally high turbidity levels.

Guideline 1.7(l): Reduction or blockage of water flow or natural circulation patterns within or into an estuarine system or a wetland forest.

Response 1.7(l): Changes to existing flow distributions are the major impact (and objective) of the project. See response to Guideline 1.7(a). By raising stages in all natural passes and ensuring flow to the west bank via new freshwater outlets, net impact of these changes in flow distribution is expected to be positive.

Guideline 1.7(m): Discharges of pathogens or toxic substances into coastal waters.

Response 1.7(m): Because of the altered flow distribution, ambient discharges of pathogens and toxic substances would also be altered. In areas receiving greater flow volumes, more of these substances would be discharged; however, concentrations would not be expected to change. Because of the unconfined disposal of dredged material in open water, with marsh created as a by-product, significant adverse effects from toxic substances within the dredged material would be limited, as discussed in EIS Appendix E, "Water Quality." Construction of upland banks with dredged material would induce release of toxic substances into the river; however, these releases would be diluted immediately, resulting in no impact.

Guideline 1.7(n): Adverse alteration or destruction of archeological, historical, or other cultural resources.

Response 1.7(n): As discussed in EIS Section 6.19, "National Register of Historic Places," the project would not result in the adverse alteration or destruction of archeological, historical, or other cultural resources.

Guideline 1.7(o): Fostering of detrimental secondary impacts in undisturbed or biologically highly productive wetland areas.

Response 1.7(o): The bank nourishment feature would create upland; however, predominant drainage would be riverward rather than toward marshes. Bioassays of marsh plants in flooded dredged-material soils indicate a higher potential for bioaccumulation than marsh plants grown on natural-marsh soils. For additional information, refer to discussions in EIS Appendix E, "Water Quality."

Guideline 1.7(p): Adverse alteration or destruction of unique or valuable habitats, critical habitat for endangered species, important wildlife or fishery breeding or nursery areas, designated wildlife management or sanctuary areas, or forestlands.

Response 1.7(p): The project would result in the loss of 270 acres of natural levee forest between 1985 and 1987. As discussed in EIS Appendix B, "Biological Assessment of Endangered/Threatened Species," no endangered/threatened species or critical habitat would be impacted by the recommended project.

Guideline 1.7(q): Adverse alteration or destruction of public parks, shoreline access points, public works, designated recreational areas, scenic rivers, or other areas of public use and concern.

Response 1.7(q): No adverse alteration or destruction of public parks, shoreline access points, public works, designated recreational areas, scenic rivers, or other areas of public use and concern would occur. Although the construction of foreshore dikes would eliminate unlimited access to the Mississippi River banks between Venice and the gulf, access would still be available through the outlets displayed on Plate 8 of Appendix E, "Water Quality." Ship traffic on the river, with the

resultant waves, presently limits riverbank access, thus forcing most people to gain access to the banks through the existing outlets as displayed on Plate 1 of Appendix E, "Water Quality." The net effect of the foreshore dikes on shoreline access should, therefore, be insignificant. As discussed in EIS Section 6.27, "Recreation," the project marsh creation should enhance recreational activities within the project area.

Guideline 1.7(r): Adverse disruptions of coastal wildlife and fishery migratory patterns.

Response 1.7(r): No significant disruption of coastal wildlife and fishery migratory patterns is expected to result from project construction and maintenance.

Guideline 1.7(s): Land loss, erosion, and subsidence.

Response 1.7(s): Land loss because of erosion, subsidence, and oil/gas industry activities is a major problem in the project area. The project would not contribute to the on-going loss rate; and, in fact, marsh creation as a result of dredged-material disposal would counter the loss rate to a slight degree.

Guideline 1.7(t): Increases in the potential for flood, hurricane or other storm damage, or increases in the likelihood that damage will occur from such hazards.

Response 1.7(t): Construction and maintenance of the project would not increase the potential for flood, hurricane, or other storm damage, or increase the likelihood that damage would occur from such hazards.

Guideline 1.7(u): Reduction in the long-term biological productivity of the coastal ecosystem.

Response 1.7(u): The creation of marsh associated with the project would contribute to the long-term biological productivity of the coastal ecosystem.

Guideline 1.8: In those guidelines in which the modifier "maximum extent practicable" is used, the proposed use is in compliance with the guideline, if the standard modified by the term is complied with. If the modified standard is not complied with, the use will be in compliance with the guideline if the permitting authority finds, after a systematic consideration of all pertinent information regarding the use, the site and the impacts of the use as set forth in Guideline 1.6, and a balancing of their relative significance, that the benefits resulting from the proposed use would clearly outweigh the adverse impacts resulting from noncompliance with the modified standard and there are no feasible and practical alternative locations, methods, and practices for the use that are in compliance with the modified standard and:

(a) significant public benefits will result from the use, or;

(b) the use would serve important regional, state, or national interests, including the national interest in resources and the siting of facilities in the coastal zone identified in the coastal resources program, or;

(c) the use is coastal water dependent.

Response 1.8: Acknowledged.

Guideline 1.9: Uses shall to the maximum extent practicable be designed and carried out to permit multiple concurrent uses which are appropriate for the location and to avoid unnecessary conflicts with other uses of the vicinity.

Response 1.9: Acknowledged.

Guideline 1.10: These guidelines are not intended to be, nor shall they be, interpreted to allow expansion of governmental authority beyond that established by LA R.S. 49:213.21, as amended; nor shall these guidelines be interpreted so as to require permits for specific uses legally commenced or established prior to the effective date of the coastal use permit program nor to normal maintenance or repair of such uses.

Response 1.10: Acknowledged.

## 2. GUIDELINES FOR LEVEES

Guideline 2.1: The leveeing of unmodified or biologically productive wetlands shall be avoided to the maximum extent practicable.

Response 2.1: The construction and maintenance of the project would reduce the overbank flow of Mississippi River water to adjacent wetlands; however, outlets have been incorporated into the foreshore dikes to minimize any adverse impacts.

Guideline 2.2: Levees shall be planned and sited to avoid segmentation of wetland areas and systems to the maximum extent practicable.

Response 2.2: The foreshore dikes and bank nourishment would be constructed within the banks of the Mississippi River below Venice and Southwest Pass. These waterways and their banks presently serve to segment wetlands to a limited degree.

Guideline 2.3: Levees constructed for the purpose of developing or otherwise changing the use of a wetland area shall be avoided to the maximum extent practicable.

Response 2.3: The foreshore dikes and bank nourishment would not be constructed for the purpose of developing or changing the use of adjacent wetlands.

Guideline 2.4: Hurricane and flood protection levees shall be located at the nonwetland/wetland interface or landward to the maximum extent practicable.

Response 2.4: No hurricane or flood protection levees would be constructed as part of the recommended project. Construction of the foreshore dikes and bank nourishment would occur within the Mississippi River and Southwest Pass and would not impact adjacent marshes directly.

Guideline 2.5: Impoundment levees shall only be constructed in wetland areas as part of approved water or marsh management projects or to prevent release of pollutants.

Response 2.5: No impoundment levees would be constructed in wetlands.

Guideline 2.6: Hurricane or flood protection levee systems shall be designed, built and thereafter operated and maintained utilizing best practical techniques to minimize disruptions of existing hydrologic patterns, and the interchange of water, beneficial nutrients, and aquatic organisms between inclosed wetlands and those outside the levee system.

Response 2.6: The construction of freshwater outlets through the foreshore dikes and bank nourishment would reduce disruptions of existing hydrologic patterns and interchange of water and allow the movement of beneficial nutrients and aquatic organisms.

## 3. GUIDELINES FOR LINEAR FACILITIES

Guideline 3.1: Linear-use alignments shall be planned to avoid adv impacts on areas of high biological productivity or irreplaceable resource areas.

Response 3.1: Direct project construction impacts have been limite areas between the existing banks of the Mississippi River below Ven and Southwest Pass to avoid direct adverse impacts on adjacent wetl

Guideline 3.2: Linear facilities involving the use of dredging or filling shall be avoided in wetland and estuarine areas to the maxi extent practicable.

Response 3.2: No dredging would occur within marsh areas and uncon disposal of dredged material would result in the creation of marsh.

Guideline 3.3: Linear facilities involving dredging shall be of th minimum practical size and length.

Response 3.3: The dredging associated with the project would be th minimum required to accomplish the project purpose. The dimensions the existing 40-foot channel are those required for safe navigatior

Guideline 3.4: To the maximum extent practicable, pipelines shall installed through the "push ditch" method and the ditch backfilled.

Response 3.4: Pipelines would not be installed as part of this prc with the exception of floating pipelines for disposal of hydraulics dredged material.

Guideline 3.5: Existing corridors, rights-of-way, canals, and streams shall be utilized to the maximum extent practicable for linear facilities.

Response 3.5: Project construction and maintenance would occur within the existing rights-of-way for the ongoing "Mississippi River, Baton Rouge to the Gulf, Louisiana," project.

Guideline 3.6: Linear facilities and alignments shall be, to the maximum extent practicable, designed, and constructed to permit multiple uses consistent with the nature of the facility.

Response 3.6: The project has been designed and constructed to permit multiple uses consistent with the project purpose of maintaining the 40-foot navigational channel.

Guideline 3.7: Linear facilities involving dredging shall not traverse or adversely affect any barrier island.

Response 3.7: The project would not traverse or adversely affect any barrier island.

Guideline 3.8: Linear facilities involving dredging shall not traverse beaches, tidal passes, protective reefs, or other natural gulf shoreline unless no other alternative exists. If a beach, tidal pass, reef, or other natural gulf shoreline must be traversed for a non-navigation canal, they shall be restored at least to their natural condition immediately upon completion of construction. Tidal passes shall not be permanently widened or deepened, except when necessary to conduct the use. The available restoration techniques which improve the traversed area's ability to serve as a shoreline shall be used.

Response 3.8: The project would not traverse beaches, tidal passes, protective reefs, or other natural gulf shoreline. During construction of the bank nourishment feature, dredged fill material would be obtained from the 40-foot navigational channel. Additional material might be required to build the bank nourishment on schedule. This additional material would be obtained by dredging within the navigational channel to a maximum 55-foot depth, where necessary. If additional material is required, it would probably be at various isolated locations so that a continuous channel, deeper than 40 feet, would not be expected. Any areas deepened during construction would shoal in rapidly once construction is complete. Additional information is contained in EIS Section 4.1.3. "Bank Nourishment."

Guideline 3.9: Linear facilities shall be planned, designed, located, and built using the best practical techniques to minimize disruption of natural hydrologic and sediment transport patterns, sheet flow, and water quality and to minimize adverse impacts on wetlands.

Response 3.9: Natural hydrologic and sediment transport patterns are no longer adequate to maintain either the wetland areas of the active delta or navigational channels. In general, project conditions would allow cost-effective maintenance of the navigational channel, slightly increase flows to the east delta where they are critically needed, and create new marsh through the unconfined disposal of dredged material. Minor adverse impacts would be experienced in localized areas during conversion to project conditions, but eventual benefits to the area would offset these impacts. More detailed information is contained in EIS Appendix E, "Water Quality."

Guideline 3.10: Linear facilities shall be planned, designed, and built using the best practical techniques to prevent bank slumping and erosion, saltwater intrusion, and to minimize the potential for inland movement of storm-generated surges. Consideration shall be given to the

use of locks in navigation canals and channels which connect more saline areas with fresher areas.

Response 3.10: The project would not cause bank slumping, erosion, saltwater intrusion, or the inland movement of storm-generated surges within Southwest Pass or the Mississippi River below Venice. As displayed on Plate 3 of EIS Appendix E, "Water Quality," some saltwater intrusion would occur in areas adjacent to Southwest Pass as a result of project construction.

Guideline 3.11: All non-navigation canals, channels, and ditches which connect more saline areas with fresher areas shall be plugged at all waterway crossings and at intervals between crossings in order to compartmentalize them. The plugs shall be properly maintained.

Response 3.11: No such canals would be constructed as part of this project.

Guideline 3.12: The multiple use of existing canals, directional drilling, and other practical techniques shall be utilized to the maximum extent practicable to minimize the number and size of access canals, to minimize changes of natural systems, and to minimize adverse impacts on natural areas and wildlife and fisheries habitat.

Response 3.12: Acknowledged.

Guideline 3.13: All pipelines shall be constructed in accordance with parts 191, 192, and 195 of Title 49 of the Code of Federal Regulations, as amended, and in conformance with the Commissioner of Conservation's Pipeline Safety Rules and Regulations and those safety requirements established by LA R. S. 45:408, whichever would require higher standards.

Response 3.13: Acknowledged.

Guideline 3.14: Areas dredged for linear facilities shall be backfilled or otherwise restored to the pre-existing conditions upon cessation of use for navigation purposes to the maximum extent practicable.

Response 3.14: Acknowledged.

Guideline 3.15: The best practical techniques for site restoration and revegetation shall be utilized for all linear facilities.

Response 3.15: Revegetation of the bank nourishment would occur naturally as would development of marsh vegetation on dredged material deposited at appropriate elevations.

Guideline 3.16: Confined and dead-end canals shall be avoided to the maximum extent practicable. Approved canals must be designed and constructed using the best practical techniques to avoid water stagnation and eutrophication.

Response 3.16: Confined and dead-end canals would be only necessary in association with required maintenance of the inner bulkheads and jetties.

## 4. GUIDELINES FOR DREDGED SPOIL DEPOSITION

Guideline 4.1: Spoil shall be deposited utilizing the best practical techniques to avoid disruption of water movement, flow, circulation, and quality.

Response 4.1: Dredged material would be deposited in an unconfined manner in open water, and, as a result, it should not disrupt water movement, flow, circulation, and quality. Marsh would be created as a by-product of this disposal.

Guideline 4.2: Spoil shall be used beneficially to the maximum extent practicable to improve productivity or create new habitat, reduce or compensate for environmental damage done by dredging activities, or prevent environmental damage. Otherwise, existing spoil disposal areas or upland disposal shall be utilized to the maximum extent practicable rather than creating new disposal areas.

Response 4.2: The unconfined disposal of dredged material would result in the creation of between 9,000 and 13,600 acres of marsh, as discussed in EIS Section 4.1.8., "Maintenance Procedures." The proposed location of these marshes is displayed on Plate 21.

Guideline 4.3: Spoil shall not be disposed of in a manner which could result in the impounding or drainage of wetlands or the creation of development sites unless the spoil deposition is part of an approved levee or land surface alteration project.

Response 4.3: Dredged material would not be disposed in a manner which could result in the impounding or draining of wetlands or the creation of development sites.

Guideline 4.4: Spoil shall not be disposed of on marsh, known oyster or clam reefs, or in areas of submerged vegetation to the maximum extent practicable.

Response 4.4: Dredged material would not be deposited onto marsh, known oyster or clam reefs, into areas of submerged vegetation. As discussed in the EIS, dredged material would be deposited into open water only.

Guideline 4.5: Spoil shall not be disposed of in such a manner as to create a hindrance to navigation or fishing, or hinder timber growth.

Response 4.5: Dredged material would not be deposited so as to create a hindrance to navigation or fishing. As discussed in EIS Section 6.20, "Natural Levee Forest," the disposal of dredged material for construction of the bank nourishment would result in the loss of 270 acres of natural levee forest. These 270 acres would be lost to subsidence without the project.

Guideline 4.6: Spoil disposal areas shall be designed and constructed and maintained using the best practical techniques to retain the spoil at the site, reduce turbidity, and reduce shoreline erosion when appropriate.

Response 4.6: Dredged material disposed for the purpose of constructing the bank nourishment would be both protected from erosion and retained by the foreshore dikes. The creation of marsh results from the unconfined disposal of dredged material within estuarine water bodies. A minimum dredged-material retention rate of approximately 70 percent has been estimated.

Guideline 4.7: The alienation of state-owned property shall not result from spoil deposition activities without the consent of the Department of Natural Resources.

Response 4.7: No alienation of state-owned property would result from dredged-material disposal activities associated with the recommended project.

## 5. GUIDELINES FOR SHORELINE MODIFICATION

Guideline 5.1: Non-structural methods of shoreline protection shall be utilized to the maximum extent practicable.

Response 5.1: Marsh creation in areas bayward of the foreshore dikes and bank nourishment features should serve to protect these features from erosion.

Guideline 5.2: Shoreline modification structures shall be designed and built using best practical techniques to minimize adverse environmental impacts.

Response 5.2: Freshwater outlets were designed into the foreshore dikes and bank nourishment to allow Mississippi River water to continue to flow over the banks.

Guideline 5.3: Shoreline modification structures shall be lighted or marked in accordance with U. S. Coast Guard regulations; not interfere with navigation, and should foster fishing, other recreational opportunities, and public access.

Response 5.3: Project feature would be lighted or marked in accordance with U.S. Coast Guard regulations. Although the jetties, foreshore dikes, and freshwater outlets and marshes would enhance fishing and other recreational opportunities, public access would remain restricted by heavy boat traffic, with associated waves, and the remoteness of the project area.

Guideline 5.4: Shoreline modification structures shall be built using best practical materials and techniques to avoid the introduction of pollutants and toxic substances into coastal waters.

Response 5.4: By designing the bank nourishment feature riverward of the existing river banks, the introduction of pollutants and toxic substances to marsh areas is avoided. Introduction of expected levels of these substances to the river would not be detrimental because they would be diluted to ambient levels immediately. No other project feature would be expected to have potential for significant toxic pollution.

Guideline 5.5: Piers and docks and other harbor structures shall be designed and built using best practical techniques to avoid obstruction of water circulation.

Response 5.5: Not applicable.

Guideline 5.6: Marinas, and similar commercial and recreational developments shall, to the maximum extent practicable, not be located so as to result in adverse impacts on open productive oyster beds, or submerged grass beds.

Response 5.6: Not applicable.

Guideline 5.7: Neglected or abandoned shoreline modification structures, piers, docks, mooring and other harbor structures shall be removed at the owner's expense, when appropriate.

Response 5.7: Not applicable.

Guideline 5.8: Shoreline stabilization structures shall not be built for the purpose of creating fill areas for development unless part of an approved surface alteration use.

Response 5.8: The bank nourishment areas would not be constructed for the purpose of development.

Guideline 5.9: Jetties, groins, breakwaters, and similar structures shall be planned, designed, and constructed so as to avoid to the maximum extent practicable downstream land loss and erosion.

Response 5.9: No downstream land loss or erosion would be expected as a result of the construction of the project features.

## 6. GUIDELINES FOR SURFACE MODIFICATIONS

Guideline 6.1: Industrial, commercial, urban, residential, and recreational uses are necessary to provide adequate economic growth and development. To this end, such uses will be encouraged in those areas of the coastal zone that are suitable for development. Those uses shall be consistent with the other guidelines and shall, to the maximum extent practicable, take place only:

a. on lands 5 feet or more above sea level or within fast lands; or

b. on lands which have foundation conditions sufficiently stable to support the use, and where flood and storm hazards are minimal or where protection from these hazards can be reasonably well achieved, and where the public safety would not be unreasonably endangered; and

1) the land is already in high intensity of development use, or

2) there is adequate supporting infrastructure, or

3) the vicinity has a tradition of use for similar habitation or development

Response 6.1: The project purpose is to maintain an existing navigational project.

Guideline 6.2: Public and private works projects such as levees, drainage improvements, roads, airports, ports, and public utilities are necessary to protect and support needed development and shall be encouraged. Such projects shall, to the maximum extent practicable, take place only when:

a. they protect or serve those areas suitable for development pursuant to Guideline 6.1; and

b. they are consistent with the other guidelines; and

c. they are consistent with all relevant adopted state, local, and regional plans.

Response 6.2: Acknowledged.

Guideline 6.3: BLANK (deleted).

Guideline 6.4: To the maximum extent practicable wetland areas shall not be drained or filled. Any approved drain or fill project shall be designed and constructed using best practical techniques to minimize present and future property damage and adverse environmental impacts.

Response 6.4: To the maximum extent practicable, no marsh would be drained or filled as part of this project.

Guideline 6.5: Coastal water-dependent uses shall be given special consideration in permitting because of their reduced choice of alternatives.

Response 6.5: Acknowledged.

Guideline 6.6: Areas modified by surface alteration activities shall, to the maximum extent practicable, be revegetated, refilled, cleaned, and restored to their predevelopment condition upon termination of the use.

Response 6.6: Bank nourishment areas and marsh creation sites would revegetate naturally.

Guideline 6.7: Site clearing shall, to the maximum extent practicable, be limited to those areas immediately required for physical development.

Response 6.7: The loss of 270 acres of natural levee forest would be the minimum loss necessary to complete construction of the bank nourishment feature.

Guideline 6.8: Surface alterations shall, to the maximum extent practicable, be located away from critical wildlife areas and vegetation areas. Alterations in wildlife preserves and management areas shall be conducted in strict accord with the requirements of the wildlife management body.

Response 6.8: Project construction activities would take place within the banks of the Mississippi River below Venice and Southwest Pass and no wildlife refuge or management area would be directly impacted.

Guideline 6.9: Surface alterations which have high adverse impacts on natural functions shall not occur, to the maximum extent practicable, on barrier islands and beaches, isolated cheniers, isolated natural ridges or levees, or in wildlife and aquatic species breeding or spawning areas, or in important migratory routes.

Response 6.9: The project would not impact any of the listed habitats adversely, with the exception of natural levee forest, as discussed in EIS Section 6.20, "Natural Levee Forest."

Guideline 6.10: The creation of low dissolved oxygen conditions in the water or traps for heavy metals shall be avoided to the maximum extent practicable.

Response 6.10: Occurrences of low dissolved oxygen are unlikely. River levels are normally above 8.0 mg/l and gulf waters are normally above 5.0 mg/l within the project area. During dredging, DO might decrease temporarily because of high organic loads; however, no significant impacts would be expected. Marshes could be a trap for heavy metals although, as discussed in EIS Appendix E, "Water Quality," levels would not be expected to become unacceptably high.

Guideline 6.11: Surface mining and shell dredging shall be carried out utilizing the best practical techniques to minimize adverse environmental impacts.

Response 6.11: Not applicable.

Guideline 6.12: The creation of underwater obstructions which adversely affect fishing or navigation shall be avoided to the maximum extent practicable.

Response 6.12: Acknowledged.

Guideline 6.13: Surface alteration sites and facilities shall be designed, constructed, and operated using the best practical techniques to prevent the release of pollutants or toxic substances into the environment and minimize other adverse impacts.

Response 6.13: Design of the bank nourishment feature riverward of the existing river banks would minimize pollutant levels in marshes, to the maximum extent practicable.

Guideline 6.14: To the maximum extent practicable, only material that is free of contaminants and compatible with the environmental setting shall be used as fill.

Response 6.14: Based on many years of data and the analysis discussed in EIS Appendix E, "Water Quality," the dredged material in the project area, to be used as fill in the bank nourishment feature, is relatively free of contaminants. The potential problem parameters have been discussed. In addition, it would be completely impractical to use any other source of fill material.

## 7. GUIDELINES FOR HYDROLOGIC AND SEDIMENT TRANSPORT MODIFICATIONS

Guideline 7.1: The controlled diversion of sediment-laden waters to initiate new cycles of marsh building and sediment nourishment shall be encouraged and utilized, whenever such diversion will enhance the viability and productivity of the outfall area. Such diversions shall

incorporate a plan for monitoring and reduction and/or amelioration the effects of pollutants present in the freshwater source.

Response 7.1: The freshwater outlets would ensure continued overba flows and would enhance the productivity of adjacent areas by the introduction of sediment and nutrients. The four outlets in the we bank of the Mississippi River between Venice and Head of Passes wou supply 50 percent of the river water presently entering the overban area during low flows in the river (see Tables 3 and 13 in Appendix "Water Quality"). The two outlets in the east bank within the same river reach would at least maintain the existing flows entering the overbank during low flows in the river (see Tables 2 and 12 in Appe E, "Water Quality"). No plan to monitor and reduce or ameliorate effects of pollutants in the freshwater source (Mississippi River) included because Mississippi River water is presently flowing into overbank areas and the project would not result in a substantial increase of these flows.

Guideline 7.2: Sediment deposition systems may be used to offset l loss, to create or restore wetland areas, or enhance building chara istics of a development site. Such systems shall only be utilized part of an approved plan. Sediment from these systems shall only b discharged in the area that the proposed use is to be accomplished.

Response 7.2: Marsh creation associated with the project would oc existing approved dredged-material disposal areas.

Guideline 7.3: Undesirable deposition of sediments in sensitive h or navigation areas shall be avoided through the use of the best preventive techniques.

Response 7.3: Acknowledged.

Guideline 7.4: The diversion of freshwater through siphons and controlled conduits and channels and overland flow to offset saltwater intrusion and to introduce nutrients into wetlands shall be encouraged and utilized whenever such diversion will enhance the viability and productivity of the outfall area. Such diversions shall incorporate a plan for monitoring and reduction and/or amelioration of the effects of pollutants present in the freshwater source.

Response 7.4: See Response 7.1.

Guideline 7.5: Water or marsh management plans shall result in an overall benefit to the productivity of the area.

Response 7.5: Marsh creation and freshwater outlets should result in an overall benefit to the productivity of the project area.

Guideline 7.6: Water control structures shall be assessed separately based on their individual merits and impacts and in relation to their overall water or marsh management plan of which they are a part.

Response 7.6: Acknowledged.

Guideline 7.7: Weirs and similar water control structures shall be designed and built using the best practical techniques to prevent "cut arounds," permit tidal exchange in tidal areas, and minimize obstruction of the migration of aquatic organisms.

Response 7.7: The freshwater outlets, as displayed on EIS Plates 3, 8, and 9, have been so designed.

Guideline 7.8: Impoundments which prevent normal tidal exchange and/or the migration of aquatic organisms shall not be constructed in brackish and saline areas to the maximum extent practicable.

Response 7.8: The foreshore dikes and bank nourishment would reduce overbank flow from the Mississippi River below Venice and Southwest Pass. These features would not, however, be expected to prevent normal tidal exchange and/or migration of aquatic organisms in the brackish to saline marshes adjacent to the lower reaches of Southwest Pass.

Guideline 7.9: Withdrawal of surface and ground water shall not result in saltwater intrusion or land subsidence to the maximum extent practicable.

Response 7.9: Acknowledged.

## 8. GUIDELINES FOR DISPOSAL OF WASTES

Dredged material, disposed in an unconfined fashion within existing approved open-water disposal areas, would not be considered a waste as defined in the Coastal Use Guidelines; therefore, these guidelines are not considered applicable.

## 9. GUIDELINES FOR USES THAT RESULT IN THE ALTERATION OF WATERS DRAINING INTO COASTAL WATERS

Guideline 9.1: Upland and upstream water management programs which affect coastal waters and wetlands shall be designed and constructed to

preserve or enhance existing water quality, volume, and rate of flow to the maximum extent practicable.

Response 9.1: Acknowledged.

Guideline 9.2: Runoff from developed areas shall, to the maximum extent practicable, be managed to simulate natural water patterns quantity, quality, and rate of flow.

Response 9.2: Not applicable.

Guideline 9.3: Runoff and erosion from agricultural lands shall be minimized through the best practical techniques.

Response 9.3: Not applicable.

### 10. GUIDELINES FOR OIL, GAS, AND OTHER MINERAL ACTIVITIES

No oil, gas, or other mineral-related activities would be associated with the recommended project; therefore, these guidelines are not considered applicable.

## CONSISTENCY DETERMINATION

The first section of this EIS appendix, "Coastal Use Guidelines," contains an evaluation of the recommended project relative to each Coastal Use Guideline. Based on this evaluation, the New Orleans District of the U. S. Army Corps of Engineers has determined that the recommended project, as described in EIS Section 4.1., "Recommended Project," is consistent, to the maximum extent practicable, with the State of Louisiana's Coastal Resources Program.

MISSISSIPPI RIVER, BATON ROUGE TO GULF
LOUISIANA, PROJECT

DRAFT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT II

APPENDIX H
DRAFT FISH AND WILDLIFE COORDINATION ACT REPORT

APRIL, 1984

MISSISSIPPI RIVER - BATON ROUGE

TO THE GULF OF MEXICO, LOUISIANA

GENERAL DESIGN MEMORANDUM

SUPPLEMENT NO. 2

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DRAFT FISH AND WILDLIFE COORDINATION

ACT REPORT

SUBMITTED TO

NEW ORLEANS DISTRICT

U.S. ARMY CORPS OF ENGINEERS

NEW ORLEANS, LOUISIANA

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PREPARED BY

DAVID L. HANKLA, FISH AND WILDLIFE BIOLOGIST

UNDER THE SUPERVISION OF

DAVID W. FRUGE, FIELD SUPERVISOR

DIVISION OF ECOLOGICAL SERVICES

LAFAYETTE, LOUISIANA

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RELEASED FROM

U.S. FISH AND WILDLIFE SERVICE

LAFAYETTE FIELD OFFICE

LAFAYETTE, LOUISIANA

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FEBRUARY 1984

EXECUTIVE SUMMARY

The attached document is the draft report of the Fish and Wildlife Service (FWS) on Supplement No. 2 to the General Design Memorandum for the project, "Mississippi River, Baton Rouge to the Gulf of Mexico, Louisiana" (hereafter referred to as Supplement 2). The project was authorized under the River and Harbor Act of March 2, 1945, Public Law 11-79th Congress, 1st Session. The attached report was prepared in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). FWS reporting responsibilities under the referenced Act will ultimately be fulfilled with the submission of a final Fish and Wildlife Coordination Act report on that project.

The project will reduce the amount of maintenance dredging required to keep Southwest Pass of the Mississippi River open to navigation. The Corps of Engineers (Corps) plans to construct foreshore dikes, lateral pile dikes, bank nourishment features, bulkheads, and jetty stabilization features in the Mississippi River and Southwest Pass. To reduce saltwater intrusion, freshwater outlets have been incorporated into the recommended plan. Marsh creation would result from maintenance of the 40-foot navigation channel.

The project area includes the Mississippi River and Southwest Pass of the Mississippi River, south of Venice, Louisiana. Typical habitats include the Mississippi River and its distributaries, natural levees, marshes, shallow ponds and lakes, dredged spoil disposal areas (scrub/shrub), and open water bodies. The project area is characterized by a high land-loss rate caused by subsidence and erosion. The project area wetlands support an abundance of estuarine-dependent fishery resources, resident and migratory waterfowl and other migratory birds, commercially important furbearers, reptiles, and amphibians.

The FWS's Habitat Evaluation Procedures (HEP) were used to assess impacts on wildlife habitat quality and quantity (Appendix A). An analysis of project effects on selected economically important fish and wildlife species (Appendix B) was also performed. These analyses were based on a comparison of future without-project (FWOP) and future with-project (FWP) conditions to a projected baseline condition. This "baseline projection" (BP) was performed for the various affected habitats and was based upon observed habitat changes in the project area between 1956 and 1978.

The major project impact on fish and wildlife habitat is the marked increase in the annualized (average annual) acreage of marsh habitat and the reduction in the acreage of estuarine water bodies under both FWOP and FWP conditions. Approximate annualized differences in marsh acreage range from +11,000 to +14,000 acres under FWOP conditions and from +6,000 to +9,000 acres under FWP conditions. These net increases in marsh acreage were reflected in both the HEP and man-day/monetary analyses.

Under FWOP conditions, the total annualized gain in commercial saltwater finfishes, crabs, and shrimp ranged from approximately 4,415,600 to 5,551,300 pounds, and under FWP conditions, this increase was about 2,419,000 to 3,513,800 pounds. Increases in potential man-days of sport fishing (annualized) ranged from 127,000 to 180,100 man-days under FWP conditions.

The HEP analysis for wildlife impacts revealed that total increases in average annual habitat units (AAHU's) under FWOP conditions ranged from 11,500 to 13,200. Under FWP conditions, increases in AAHU's ranged from 4,700 to 6,400. The only evaluation species to show a decline were terns and skimmers. The man-day/monetary analysis revealed that waterfowl hunting (annualized) would increase from 4,700 to 5,600 man-days under FWOP conditions. Under FWP conditions, increases ranged from 2,000 to 2,800 man-days.

Adverse project impacts on terns and skimmers were the result of the conversion of estuarine water bodies to marsh and scrub/shrub habitats. As this habitat change benefitted all other evaluation elements, the compensation for losses of feeding habitat utilized by terns and skimmers is not considered appropriate. The limiting factor for terns and skimmers in the project area is nesting habitat, which is provided by the bare sand deposits resulting from maintenance spoil disposal. Tern and skimmer populations are not expected to be reduced by this project.

Project implementation would also have unquantified impacts on fish and wildlife resources. Flows through Grand Pass on the west bank of the Mississippi River, and Cubits Gap on the east bank of the Mississippi River, are projected to increase with project implementation. The increased flows through Grand Pass, in conjunction with the previously-mentioned freshwater outlets, are expected to compensate for reduced overbank flows and maintain the existing salinity regime in that portion of the project area which lies west of the Mississippi River above Head of Passes. Increased flows through Cubits Gap should increase the volume of river-borne sediments transported to Delta NWR, possibly enhancing marsh accretion in that area.

Should flows through Grand Pass and Cubits Gap not increase as anticipated, or achieve the anticipated results, adverse impacts to fish and wildlife resources in the aforementioned areas, east and west of the Mississippi River, would occur. Saltwater intrusion and an accelerated marsh loss rate could result from reduced overbank flows due to proposed bank nourishment features.

According to the HEP analysis, both FWP and FWOP conditions would improve fish and wildlife habitat over BP conditions. However, these improvements are predicated upon dramatic annualized increases in marsh acreage attributable to spoil deposition, and maintenance of desirable salinity and freshwater distribution patterns. Project implementation coupled with a failure to maximize marsh creation and to maintain salinity and freshwater distribution patterns might serve to further aggravate the present marsh deterioration condition in the

project area. Thus, every effort must be made to ensure that a minimum of 9,000 acres of marsh is created as a result of the project maintenance, and that desirable salinity and freshwater distribution patterns are maintained. Therefore the FWS makes the following recommendations in the interest of fish and wildlife conservation:

1) all spoil material not essential for bank nourishment should be used to maximize marsh creation. Toward this end, spoil material should be deposited in such a manner as to maximize the area and time in which the surface of the dredged material would be between +1.0 and +2.0 feet NGVD;

2) marsh creation efforts on the east side of Southwest Pass below mile 8.8 Below Head of Passes should be aided with construction of an upland barrier (beach ridge) created by spoil deposition in open water. This barrier would also serve to reduce adverse project impacts to terns and skimmers by providing additional nesting habitat; and

3) the Corps of Engineers, assisted by an interagency advisory group comprised of representatives of the Louisiana Department of Wildlife and Fisheries, National Marine Fisheries Service, Environmental Protection Agency, and the FWS, should monitor marsh creation efforts and salinity and freshwater distribution patterns throughout the life of the proposed project modifications. Appropriate adjustments in project design should be made if such monitoring efforts reveal the need to do so, in order to maximize marsh creation or re-establish desirable salinity and freshwater distribution patterns.

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APPENDICES

## PROJECT DESCRIPTION

### General

The New Orleans District, Corps of Engineers is preparing Supplement No. 2 to the General Design Memorandum for the project, "Mississippi River, Baton Rouge to the Gulf of Mexico, Louisiana" (hereafter referred to as Supplement 2). The project was authorized by the River and Harbor Act of March 2, 1945, Public Law 14--79th Congress, 1st Session. The Act authorizes construction in accordance with the plans recommended in the report of the Chief of Engineers, printed in House Document No. 215, 76th Congress, 1st Session.

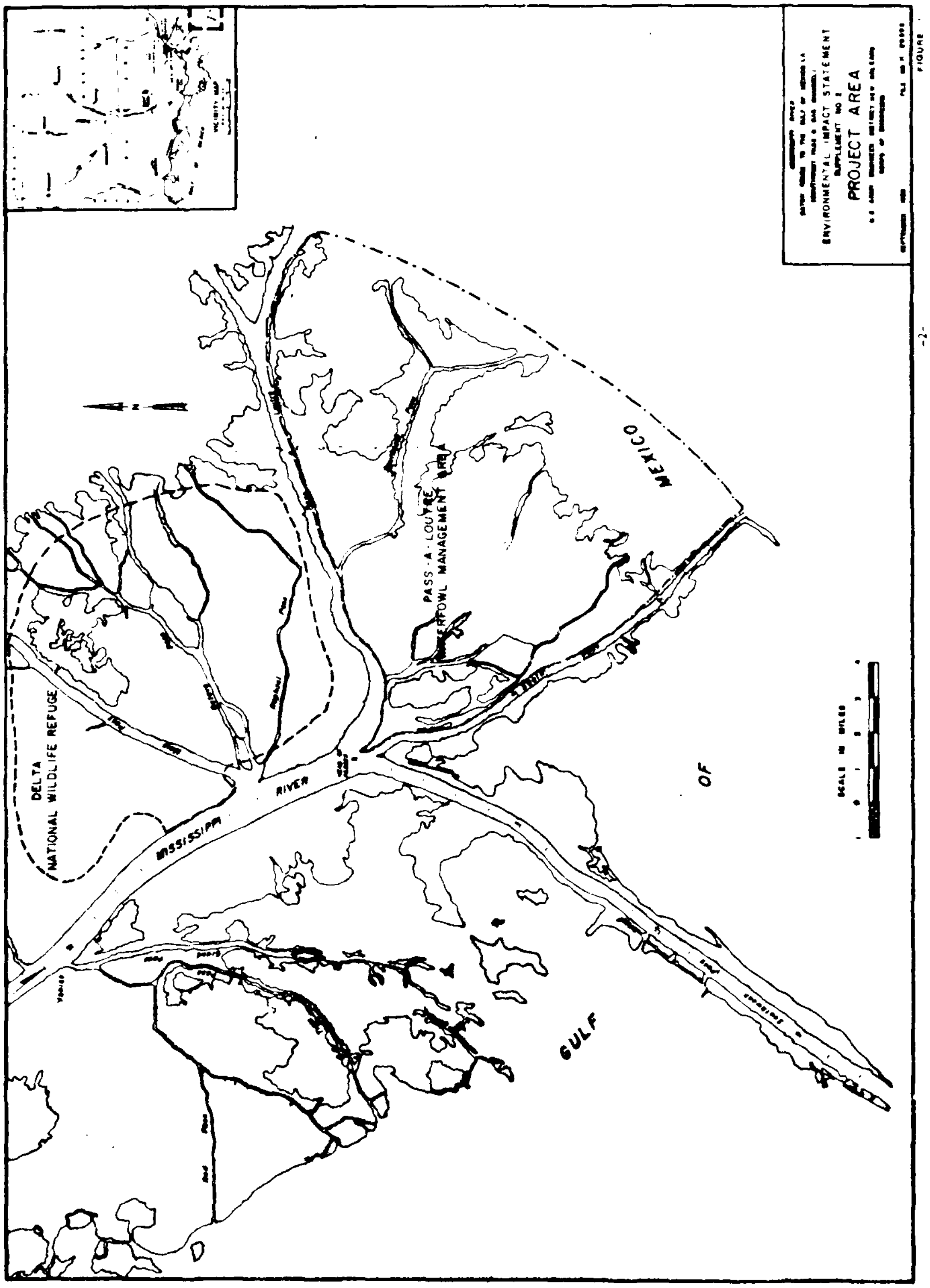
The purpose of project modifications under consideration is to reduce the amount of maintenance dredging required to keep Southwest Pass open to navigation. Modifications contained in the tentatively selected plan include construction of foreshore dikes, bank nourishment, freshwater outlets, jetty stabilization, and inner bulkheads. Marsh creation with dredged material would be associated with maintenance of the present 40-foot-deep navigation channel. Lateral pile dikes are also a future consideration. Project features would be located in and along the Mississippi River from mile 8.8 above Head of Passes (AHP) at Venice, Louisiana, to the Southwest Pass jetties at mile 18.8 below Head of Passes (BHP) as displayed in Figure 1. Construction would begin in 1985 and end in 1992. Project life would extend an additional 50 years to 2042. It is anticipated that there would be a 7.3 million cubic yard reduction in annual maintenance dredging quantities with implementation of the recommended plan.

### Foreshore Dikes

Foreshore dikes would be aligned with the minus 2.5 foot National Geodetic Vertical Datum (NGVD) contour from Venice to Head of Passes. From Head of Passes to mile 18.8 BHP, the foreshore dikes would be aligned with the minus 1.8 foot NGVD contour. These dikes are to be made of stone and would be approximately 90 feet wide at the base. Between Venice and Head of Passes, the height of the foreshore dikes would be 11.0 feet NGVD, and from Head of Passes to mile 18.8 BHP, the height would be 10.0 to 10.5 feet NGVD. Flotation channels would be dredged adjacent to the foreshore dikes to provide access for construction and maintenance equipment.

### Bank Nourishment

After construction of a specific section of foreshore dike, hydraulically dredged material would be pumped over the foreshore dikes to design elevations of 4.5 feet NGVD between Venice and Head of Passes, and 4.0 feet NGVD in Southwest Pass. These design elevations would be achieved by pumping the dredged material in the two referenced segments to initial elevations of approximately [illegible].5 feet NGVD and 7.0 feet NGVD, respectively. It is anticipated that the design elevations would be attained, through subsidence and compaction, in one to six years from initial pumping. The bank nourishment feature would extend shoreward from the foreshore dike to the existing Mississippi River or Southwest Pass banks. In areas where no bank exists, the bank nourishment would extend shoreward for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PASS-A-LOUTRE
MANAGEMENT AREA
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ENVIRONMENTAL IMPACT STATEMENT
PROJECT AREA
FIGURE

200 feet at the design elevation and then assume a downward slope of approximately 1 foot vertical to 50 feet horizontal.

## Freshwater Outlets

Four low rock-weir structures which would function as outlets, each 100 feet wide, would be built in the foreshore dike on the west side of the Mississippi River at miles 7.1, 5.5, 3.5, and 2.9 AHP. These outlets would have crest elevations of 0.0 feet NGVD. The two existing outlets in the east bank of the Mississippi River at miles 4.9 and 6.45 AHP would remain open and the foreshore dike at these locations would tie into the existing bank. The purpose of these six outlets would be to maintain year-round freshwater inflow to areas that would otherwise become largely isolated from inflow by construction of the foreshore dikes and bank nourishment features. Existing low flows to the east would be maintained while 50 percent of existing low flows would be provided to the west. Foreshore dikes and bank nourishment would be overtopped during peak high water periods.

## Jetty Stabilization

The existing jetties at the mouth of Southwest Pass would be stabilized to maintain a height of 6.0 feet NGVD, a crown width of 25 feet, and a maximum bottom width of 100 feet. This would be accomplished through a combination of fascine mattress construction followed by concrete structure and rock-fill repair. Inner bulkheads would be constructed parallel and riverward of the jetties at the mouth of Southwest Pass. The design height of these bulkheads would be +6.0 feet NGVD. Approximately 7.0 million cubic yards of hydraulically dredged material would be pumped as fill between the inner bulkheads and the jetties. The design height of this fill would be 4.0 feet NGVD.

## Marsh Creation

By the end of the project life (2042), it is projected that up to 13,600 acres of marsh (fresh and non-fresh) would be created under future with-project (FWP) conditions, and up to 28,400 acres of marsh would be created under future without project (FWOP) conditions. Marsh would be created through placement of unconfined dredged material within estuarine water bodies in association with maintenance of the 40-foot navigation channel. Montz (1977) has determined that, in the vicinity of Southwest Pass, the maximum elevation for marsh creation is approximately 2.0 feet NGVD. Under FWP conditions, it was assumed that all hydraulically dredged shoal material not needed for construction or maintenance of the bank nourishment would be disposed in an unconfined manner. Under FWOP conditions, it was assumed that all hydraulically dredged shoal material not needed for maintenance of the banks would also be disposed in an unconfined manner.

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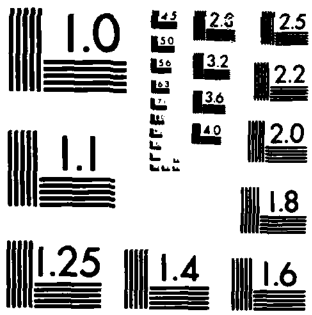


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

## Lateral Pile Dikes

Lateral pile dikes have been used extensively in Southwest Pass to reduce the cross-sectional area of the pass, thus increasing flow velocities and reducing shoaling. Model testing is underway to determine if construction of new lateral pile dikes and extension of existing dikes, in addition to the other recommended features, would result in further shoaling reductions. Approximately 16,000 feet of new lateral pile dikes would be constructed. These dikes would vary from 300 to 1,000 feet long. On the west bank of the Mississippi River and Southwest Pass, six new lateral pile dikes would be constructed between miles 0.6 BHP and 0.7 AHP while 29 existing lateral pile dikes (24 between miles 10.0 BHP and 14.4 BHP and five between miles 19.0 BHP and 20.0 BHP) would be extended. On the east bank of Southwest Pass, a total of 35 new lateral pile dikes would be constructed; nine of these would be installed between miles 1.8 BHP and 3.0 BHP and 26 would be placed between miles 10.3 BHP and 14.7 BHP.

# AREA SETTING

## Introduction

The primary area of project impact on fish and wildlife resources is the active delta of the Mississippi River, located generally south of Venice, Louisiana. The active delta of the Mississippi is contained in Hydrologic Unit 3 as described by Wicker (1980) and includes the lower Mississippi River and its distributaries; subsiding natural levees along these water courses; dredged spoil disposal areas; large expanses of fresh to brackish marsh and associated shallow ponds and lakes; and large open water bodies. The marshes are generally found at elevations between 1.0 and 2.0 feet NGVD. Natural levees usually do not exceed elevations of 5.0 feet NGVD. Extensive dredged material deposits, primarily located along Southwest Pass, sometimes exceed an elevation of 10.0 feet NGVD.

The marshes and natural levees of the project area were formed by riverborne sediments deposited in shallow open water. Engineering works in the delta, coupled with upstream diversions, reservoirs, and bank stabilization work, have resulted in a greatly reduced quantity of sediments reaching the marshes and shallow open waters of the delta. Consequently, sediment deposition has not kept pace with subsidence and erosion and a surprisingly rapid rate of marsh loss is occurring in the area. Recent studies (Wicker 1980) have shown that the total acreage of marsh in the active delta declined from 134,000 acres in 1956 to approximately 66,000 acres in 1978. A similar decline in marsh is occurring throughout the Mississippi Deltaic Plain Region (MDPR) of coastal Louisiana. Data compiled by Wicker (1980) show a net decline of about 465,500 acres of marsh in the MDPR between the mid-1950's and 1978. Barring any significant structural alterations in the delta, the rapid rate of marsh loss in the project area is expected to continue into the future.

## Description of Habitats

There are numerous habitat types within the project area. For impact analysis purposes, these various habitats were condensed into six major habitat types. The following is a description of the habitat types which were used in assessing project impacts.

Natural Levee Forest - These forested wetlands (Palustrine Forested Wetlands according to Cowardin et al. 1979) are located on subsiding natural levees along Tiger, Grand, and Raphael Passes and along the west bank of the Mississippi River between Venice and Head of Passes. Typical vegetation includes black willow, green ash, persimmon, red maple, and scattered bald cypress.

Fresh Marsh - This habitat type has been classified as Palustrine Emergent Wetlands according to Cowardin et al. (1979). Common vegetation in the fresh marshes includes alligator weed, water hyacinth, elephant's ear, wild millet, dogtooth grass, common reed, delta duck potato, and duckweed.

Non-fresh Marsh - These intermediate and brackish marshes (Chabreck 1972) have been classified as Estuarine Intertidal Emergent Wetlands according to Cowardin et al. (1979). Common vegetation in this habitat type includes common reed, coast bacopa, dogtooth grass, saltmarsh cordgrass, freshwater three-square, bulltongue, saltmeadow cordgrass, softstem bulrush, leafy three-square, and dwarf spikerush.

Scrub/Shrub - This habitat type is synonymous with dredged spoil disposal areas in the project area. This dredged material consists of silt, clay, and sand taken from the Mississippi River and its distributary channels. These areas are typically, but not exclusively, limited to elevations above 2.0 NGVD. Though spoil areas are initially barren, they are eventually colonized with a scrub/shrub complex of vegetation including rattlebox, seaside goldenrod, coastal bermuda, black willow, and eastern baccharis.

River - This habitat type (Riverine Tidal and Riverine Lower Perennial) includes that portion of the Mississippi River and Southwest Pass which lies between the foreshore dikes and the existing bank.

Estuarine Water Bodies - For purposes of this report, this habitat type includes marsh ponds and lakes (Estuarine, Palustrine and Lacustrine Open Water); estuarine bays and lakes in off-channel areas (Estuarine Open Water); Palustrine Aquatic Bed characterized by stands of Eurasian watermilfoil, coontail, and fanwort; and Estuarine Aquatic Bed characterized by stands of widgeongrass and Eurasian watermilfoil.

## Fishery Resources

Freshwater - Based on studies by Kelly (1965), it can be concluded that most of the freshwater fishes in the active delta are limited to waters having a salinity of less than 5 ppt. Freshwater species occur in the Mississippi River and its distributaries, in petroleum industry access canals, and in the ponds and lakes within the fresh and intermediate marshes. Primary freshwater sportfishes include

largemouth bass, yellow bass, black crappie, bluegill, warmouth, channel catfish, and blue catfish. Data compiled by the U.S. Fish and Wildlife Service (1976) for the Louisiana Coastal Area Study revealed that Hydrologic Unit 3 supported 18,000 man-days of freshwater sport fishing in 1968 with an estimated harvest of 45,000 pounds.

The commercial freshwater fishery is also important in the project area. Primary species harvested are alligator gar, blue catfish, and channel catfish. Harvest records from Delta National Wildlife Refuge indicate a commercial freshwater finfish harvest of over 200,000 pounds in 1981 (T. Heuer, Personal Communication, March 3, 1982). A commercial freshwater finfish harvest of 327,200 pounds during 1978 was reported for Plaquemines Parish by the National Marine Fisheries Service.

Saltwater - The diverse sport and commercial saltwater fisheries of the study area are of great importance. The nutrient-rich water in the Mississippi River in conjunction with the tidal marshes, aquatic vegetation beds, and shallow estuarine waters provide productive habitat to a variety of crustaceans and finfishes. Common sport and commercial saltwater species found in the project area and adjacent Gulf waters are shown in Table 1. Based on an extensive telephone survey, the U.S. Fish and Wildlife Service (1976) has estimated that, in 1968, Hydrologic Unit 3 supported 39,000 man-days of saltwater sportfishing, 18,000 man-days of sport shrimping, and 3,000 man-days of sport crabbing. National Marine Fisheries Service harvest records indicated an estuarine-dependent commercial finfish/shellfish harvest from Plaquemines Parish of over 17 million pounds in 1977 and 18.1 million pounds in 1978.

The importance of coastal marshes to estuarine-dependent fisheries production cannot be over-emphasized. These marshes produce vast amounts of organic detritus which are transported into adjacent estuarine waters. This detritus is extremely important in the maintenance of fish and shellfish productivity. The contribution of vascular plant detritus to estuarine fisheries productivity is documented in a publication by Odum et al. (1973). Marshes and associated shallow waters are also extremely important as habitat for many estuarine-dependent species. Recent studies conducted within the upper Barataria Basin have substantiated the value of shallow marsh areas as nursery habitat for Atlantic croaker, spot (Rogers 1979), and menhaden (Simoneaux 1979). Shallow marsh areas are also important as nursery grounds for white shrimp and brown shrimp in coastal Louisiana, according to studies conducted by biologists of the Louisiana Wildlife and Fisheries Commission (White and Boudreaux 1977). Studies in Texas have also documented the importance of tidal marshes as habitat for blue crabs (More 1969). A three-year investigation of a low-salinity marsh area of the Galveston Bay System of southeastern Texas revealed that shallow marsh waters were prime habitat for immature shrimp (brown and white), gulf menhaden, Atlantic croaker, sand seatrout and southern flounder (Conner and Truesdale 1973).

There is growing evidence that the acreage of marsh is the most important factor influencing the production of estuarine-dependent fishes of sport and commercial importance. Turner (1979) reported

Table 1. A list of common estuarine and marine fishes and shellfishes of commercial or recreational importance in the study area.[a]

| Common Name | Common Name |
|---|---|
| Shortfin mako | Vermilion snapper |
| Tiger shark | Tripletail |
| Lemon shark | Sheepshead |
| Atlantic sharpnose shark | Southern kingfish |
| Bull shark | Black drum |
| Blacktip shark | Atlantic croaker |
| Scalloped hammerhead | Spotted seatrout |
| Tarpon | Sand seatrout |
| Gulf menhaden | Red drum |
| Atlantic thread herring | Spot |
| Blue catfish | Atlantic spadefish |
| Gafftopsail catfish | Striped mullet |
| Sea catfish | Great barracuda |
| Rock hind; calico grouper | Little tuna; bonito |
| Bluefish | King mackerel |
| Cobia | Spanish mackerel |
| Blue runner | Southern flounder |
| Crevalle jack | American oyster |
| Greater amberjack | Rangia clam |
| Florida pompano | White shrimp |
| Dolphin | Brown shrimp |
| Red snapper | Pink shrimp |
| Gray snapper | Seabob |
| King whiting | Blue crab |

a. Information on distribution of fishes listed taken primarily from Hoese and Moore (1977).

that the Louisiana commercial inshore shrimp catch is directly proportional to the area of intertidal wetlands and that the area of estuarine water does not seem to be directly linked to shrimp yields. Harris (1973) has stated his opinion that total estuarine-dependent commercial fisheries production in coastal Louisiana has peaked and will decline in proportion to the acreage of marshland loss.

Wildlife Resources

Birds - Migratory waterfowl and other wetland game birds are common in the marshes and open water bodies of the study area. The greatest concentrations of dabbling ducks occur in the marshes and shallow water bodies, while diving ducks prefer deeper bays and lagoons. Migratory dabbling ducks include mallard, northern pintail, green-winged teal, gadwall, American wigeon, and northern shoveler. The resident mottled duck nests and winters in the marshes of the project area. Common divers include lesser scaup, greater scaup, redhead, ring-necked duck, canvasback, red-breasted merganser, and common merganser. The lesser snow goose and white-fronted goose utilize the marshes of the project area. Other wetland game birds in the study area are the king rail, clapper rail, sora, Virginia rail, common gallinule, purple gallinule, American coot, and common snipe. The American woodcock winters in the forested portions of the project area.

Nongame birds include several species of wading birds, seabirds, shorebirds, and songbirds. Common wading birds include the little blue heron, great blue heron, American egret, snowy egret, cattle egret, white-faced ibis, white ibis, green heron, yellow-crowned night heron, and black-crowned night heron. Seabirds include the brown pelican, white pelican, black skimmer, herring gull, laughing gull, and several species of terns. Common shorebirds in the project area include killdeer, American avocet, black-necked stilt, American oystercatcher, and numerous sandpipers. Other nongame birds in the project area marshes include marsh wrens, boat-tailed grackle, belted kingfisher, red-winged blackbird, and seaside sparrow. Forested areas support numerous species of nongame birds including the cardinal, great-horned owl, and many species of warblers.

Many waterbirds in the project area concentrate their nests in colonies and are thus highly vulnerable to habitat disturbance. Herons, egrets, and ibises nest in trees and shrubs while terns and skimmers construct their nests on the barren ground, typically a sandy beach or unvegetated sandy spoil deposit. The locations of former and active seabird and wading bird nesting colonies in the project area are shown in Table 2.

Mammals - The white-tailed deer, the only big game mammal in the study area, is found in the natural levee forests, marshes and adjacent spoil deposits. Those habitats also support small game mammals such as swamp rabbit and raccoon.

Commercially important furbearers in the project area include nutria, muskrat, mink, river otter, and raccoon. Nutria are most abundant in the fresh marshes while muskrat are most abundant in the brackish marshes, especially where three-cornered grass occurs in dense stands.

Table 2. Seabird and wading bird nesting concentrations in the project area. [a]

| Latitude (N) | Longitude (W) | Species |
|---|---|---|
| 29° 17' | 89° 11' | White-faced ibis, snowy egret, great egret, white ibis, little blue heron, black-crowned night heron, Louisiana heron |
| 29° 13' | 89° 22' | Snowy egret, great egret, little blue heron, Louisiana heron |
| 29° 08'[c] | 89° 15' | Black skimmer[b] |
| 29° 07' | 89° 13' | Snowy egret, great egret, white ibis, white-faced ibis, little blue heron, Louisiana heron, black-crowned night heron |
| 29° 06'[c] | 89° 17' | Least tern[b] |
| 29° 03'[c] | 89° 18' | Black skimmer, least tern[b] |
| 29° 01'[c] | 89° 19' | Black skimmer, gull-billed tern |
| 29° 00' | 89° 10' | Black skimmer, gull-billed tern |
| 28° 59' | 89° 09' | Least tern[b] |
| 28° 58'[c] | 89° 23' | Least tern, Forster's tern[b] |
| 28° 58' | 89° 09' | Forster's tern |

a. From Portnoy (1977) and updated by Keller (1983)

b. Not active in 1983

c. Located adjacent to Southwest Pass

Winding bayous and distributaries provide good river otter and mink habitat. Raccoons utilize vegetated dredged spoil deposits where they occur in close proximity to open water as well as marsh and natural levee forest habitats.

Amphibians and Reptiles - Frogs, toads, turtles, and snakes are abundant in the project area. The bullfrog and pig frog are sought both for commercial sale and for sport. Commercially important reptiles occurring in the marshes include the American alligator, common snapping turtle, and alligator snapping turtle. Common snakes are the diamond-backed water snake, broad-banded water snake, and western cottonmouth.

Endangered Species

The project area provides habitat for several Federally listed endangered species. Endangered birds known to utilize the project area for feeding purposes are the bald eagle, brown pelican, and Arctic peregrine falcon. No nesting by these species in the project area has been recorded in recent years. The loggerhead sea turtle and green sea turtle are classified as threatened and may occur in the Gulf of Mexico offshore from Southwest Pass. The American alligator is presently classified as "threatened under similarity of appearance" within Louisiana. Controlled commercial alligator hunts are conducted in the project area. As indicated in a January 17, 1983, letter, from the Field Supervisor of the FWS's Endangered Species Field Office in Jackson, Mississippi, to Mr. Cletis Wagahoff of the New Orleans District Corps of Engineers, the required consultation with the FWS on endangered and threatened species has been accomplished.

Areas of Special Concern

Delta National Wildlife Refuge - Delta National Wildlife Refuge (NWR) is comprised of approximately 48,000 acres of fresh and intermediate marsh, shallow ponds, and bayous. The refuge lies south of Baptiste Collette Bayou and north of Pass a Loutre on the east side of the Mississippi River. Its primary purpose is to provide habitat for wintering migratory waterfowl. During the winter of 1981-82, Delta NWR supported a peak population of about 125,000 ducks, geese, and coots. The refuge also provides excellent habitat for wading birds, songbirds, small mammals, and freshwater fishes. In 1981, over 200,000 pounds of commercial freshwater fishes valued at over $90,000 were taken on the refuge. In addition, six commercial trappers harvested over 1,900 nutria during the 1981-82 trapping season (T. Heuer, personal communication, March 3, 1982).

Present plans do not include spoil disposal on Delta NWR. Such action would require a right-of-way permit from the FWS. In order for a right-of-way to be granted, the Regional Director of the FWS must determine that the proposed use is compatible with the purpose for which the refuge was established. In instances where damages to the refuge will result, the Regional Director may require mitigation measures within the right-of-way area or on adjacent Service land. If the proposed use cannot be made compatible, no right-of-way will be granted. Service authority to issue rights-of-way is contained in

Public Law 89-669 (80 Stat. 926; 16 U.S.C. 663d) as amended.

Pass a Loutre Waterfowl Management Area - Pass a Loutre Waterfowl Management Area (WMA) is in the southern-most part of Plaquemines Parish between the south bank of Pass a Loutre and the east bank of South Pass, immediately south of Delta NWR. The area, owned by the Louisiana Department of Wildlife and Fisheries, encompasses some 66,000 acres of fresh and intermediate marsh, bayous, and shallow marsh ponds. It provides excellent habitat for numerous game and nongame birds, small mammals, and freshwater and saltwater fishes. The area is maintained primarily for public use of its fish and wildlife resources. Activities permitted on the management area include hunting, fishing, crabbing, boating, and camping. A trapping program is conducted annually to control surplus furbearing animals. An analysis of the public use on Pass a Loutre WMA for the period of July 1, 1980 to June 30, 1981 is contained in Table 3.

## IMPACT EVALUATION METHODOLOGY

Project impacts were estimated under FWOP and FWP scenarios. However, since the FWOP condition allows for maintenance of the existing navigation channel via maintenance dredging, FWS and Corps personnel did not consider this representative of the traditional FWOP condition to be utilized in project impact analyses. Thus, a "baseline projection" (BP) was developed and was the functional "future without-project condition" to which both FWOP and FWP conditions were compared. The BP condition was based upon observed habitat changes in the project area between 1956 and 1978 (Wicker 1980). These habitat change trends were then projected through the year 2042.

An in-depth analysis of the quantifiable impacts of the project on fish and wildlife resources was performed. The FWS analysis included use of a modified version of the Habitat Evaluation Procedures (HEP) to assess project impacts on wildlife habitat quality and quantity. In addition, a man-day/monetary (economic) analysis of project impacts on sport hunting, sport and commercial fishing, and fur and alligator harvest was also performed. Details of the HEP methodology are contained in Appendix A, while the procedures followed for the economic analysis are discussed in Appendix B.

Estimates of the acreages of various habitat types discussed previously were developed by FWS and Corps personnel, and were used in both impact analyses. Habitat acreages and trends of habitat change in the project area and Hydrologic Unit III from 1956 to 1978 were provided by the FWS's National Coastal Ecosystems Team (NCET) in Slidell, Louisiana, and were based on the findings of Wicker (1980). Rates of subsidence and acreages of marsh creation by target year were provided by the Corps. Utilizing these background data, Corps and FWS biologists established the acreages of each habitat type, for each target year, for FWOP, FWP, and BP conditions. The assumptions utilized for each habitat type are discussed below.

Natural Levee Forest - NCET data revealed that this habitat type has declined at the rate of 200 acres/year since 1956 in Hydrologic Unit III. This rate was assumed to continue for BP and FWOP conditions. Under FWP conditions, Corps data showed that project construction

Table 3. Recreational use of Pass a Loutre Waterfowl Management Area for the period of July 1, 1980, to June 30, 1981.[a]

| Activity | Man-days Expended |
|---|---|
| Waterfowl hunting | 12,122 |
| Rail hunting | 551 |
| Gallinule hunting | 551 |
| Sport fishing (fresh) | 3,857 |
| Sport fishing (salt) | 4,959 |
| Commercial fishing | 11,020 |
| Crabbing | 386 |
| Frogging | 110 |
| Shrimping | 11,020 |
| Trapping | 480 |
| Camping | 2,665 |
| Boating | 5,510 |
| Total | 53,231 |

a. Data provided by the Louisiana Department of Wildlife and Fisheries.

would destroy approximately 270 acres of natural levee forest over three years. These impacts were incorporated into the FWP condition projection.

Fresh Marsh - BP acreages were projected on the basis of data provided by NCET, which showed a 3.2 percent annual decline in marsh acreage in Hydrologic Unit III from 1956 to 1978. Marsh creation acreage estimates provided by the Corps for the area above mile 4.5 BHP were added to the BP conditions to formulate projections for the FWOP and FWP conditions.

Non-Fresh Marsh - The methodology used was the same used for fresh marsh, with two exceptions. Marsh creation acreages for that portion of the project area below mile 4.5 BHP were added to the BP condition in order to estimate acreages for the FWOP and FWP condition. In addition, under FWP conditions only, existing upland disposal sites (these sites have a mean elevation of 4.5 feet NGVD) no longer in use were projected to subside at approximately 3 centimeters (cm)/year and become non-fresh marsh when the average elevation was between 1.0 and 2.0 feet NGVD.

Scrub/Shrub - Using the NCET data, the change in scrub/shrub acreages was computed on an acres/year basis for the BP condition. For the FWOP condition, additional scrub/shrub acreage was added to the BP condition; this was based on the ratio of dredged material volume pumped to the acreage of uplands created between 1956 and 1978. This ratio was then applied to the greatly increased maintenance dredging requirements under the FWOP condition. The FWP condition assumed the creation of 1,500 acres of scrub/shrub due to foreshore dikes and bank nourishment. No additional upland disposal was assumed for the FWP condition. Existing upland areas were assumed to subside at the rate of 3 cm/year.

River - It was assumed that the Corps would not allow Southwest Pass to widen under any scenario. NCET data revealed that the acreage of river habitat in the project area AHP has been increasing at the rate of 6 acres/year. For BP and FWOP conditions, this rate was assumed to continue throughout project life. Under the FWP condition, it was assumed that 3,000 acres of river (including Southwest Pass) would be eliminated by construction of the foreshore dikes and bank nourishment features from 1985 to 1992.

Estuarine Water Bodies - Only the acreage of estuarine water bodies directly impacted by the project was considered. This included acres of that habitat type lost to spoil disposal or gained through subsidence of emergent habitat.

Tables 4 through 8 show the acreages by habitat type for BP, FWOP (maximum marsh creation), FWP (maximum marsh creation), FWOP (minimum marsh creation), and FWP (minimum marsh creation) scenarios; the acreages are shown for selected target years.

## PROJECT IMPACTS

### Habitat Impacts

The primary project impact is anticipated to be a substantial increase

Table 4. Acreage of specific habitat types under BP conditions by selected target years.[a]

| Target Year | Habitat Type: Estuarine Water Bodies | River | Scrub/ Shrub | Natural Levee Forest | Fresh Marsh | Non-Fresh Marsh |
|---|---|---|---|---|---|---|
| 1985 | 57,832 | 3,000 | 10,041 | 946 | 31,648 | 22,011 |
| 1986 | - | - | - | 746 | - | - |
| 1987 | - | - | - | 546 | - | - |
| 1988 | - | - | - | 346 | - | - |
| 1989 | - | - | - | 146 | - | - |
| 1990 | - | - | - | 0 | - | - |
| 1992 | 67,301 | 3,042 | 11,973 | - | 25,149 | 17,066 |
| 2006 | 78,769 | 3,127 | 15,836 | - | 15,965 | 10,834 |
| 2017 | 83,714 | 3,193 | 18,872 | - | 11,171 | 7,581 |
| 2042 | 87,087 | 3,344 | 25,771 | 0 | 4,962 | 3,367 |

a. The values in this table represent a composite of acreages, by target year, that was used in various phases of the HEP analysis. A dash (-) indicates that values for that target year/habitat type were not used in the HEP analysis.

Table 5. Acreage of specific habitat types under FWOP conditions (minimum marsh creation scenario) by selected target years.[a]

| Target Year | Habitat Type: Estuarine Water Bodies | River | Scrub/ Shrub | Natural Levee Forest | Fresh Marsh | Non-Fresh Marsh |
|---|---|---|---|---|---|---|
| 1985 | 58,163 | 3,000 | 10,041 | 946 | 31,648 | 21,680 |
| 1986 | - | - | - | 746 | - | - |
| 1987 | - | - | - | 546 | - | - |
| 1988 | - | - | - | 346 | - | - |
| 1989 | - | - | - | 146 | - | - |
| 1990 | - | - | - | 0 | - | - |
| 1992 | 64,912 | 3,042 | 12,958 | - | 25,831 | 17,788 |
| 2006 | 67,613 | 3,127 | 19,560 | - | 21,679 | 12,552 |
| 2017 | 63,410 | 3,193 | 25,732 | - | 22,048 | 10,148 |
| 2042 | 49,997 | 3,344 | 39,829 | 0 | 23,759 | 7,602 |

a. The values in this table represent a composite of acreages by target year, that was used in various phases of the HEP analysis. A dash (-) indicates that values for that target year/habitat type were not used in the HEP analysis.

Table 6. Acreage of specific habitat types under FWOP conditions (maximum marsh creation scenario) by selected target years.[a]

| Target Year | Habitat Type: Estuarine Water Bodies | River | Scrub/ Shrub | Natural Levee Forest | Fresh Marsh | Non-Fresh Marsh |
|---|---|---|---|---|---|---|
| 1985 | 57,832 | 3,000 | 10,041 | 946 | 31,648 | 22.011 |
| 1986 | - | - | - | 746 | - | - |
| 1987 | - | - | - | 546 | - | - |
| 1988 | - | - | - | 346 | - | - |
| 1989 | - | - | - | 146 | - | - |
| 1990 | - | - | - | 0 | - | - |
| 1992 | 63,993 | 3,042 | 12,958 | - | 25,831 | 18,707 |
| 2006 | 65,427 | 3,127 | 19,560 | - | 21,679 | 14,738 |
| 2017 | 60,144 | 3,193 | 25,732 | - | 22,048 | 13,414 |
| 2042 | 44,656 | 3,344 | 39,829 | 0 | 23,759 | 12,943 |

a. The values in this table represent a composite of acreages by target year, that was used in various phases of the HEP analysis. A dash (-) indicates that values for that target year/habitat type were not used in the HEP analysis.

Table 7. Acreage of specific habitat types under FWP conditions (minimum marsh creation scenario) by selected target years.[a]

| Target Year | Estuarine Water Bodies | River | Scrub/ Shrub | Natural Levee Forest | Fresh Marsh | Non-Fresh Marsh |
|---|---|---|---|---|---|---|
| | Habitat Type | | | | | |
| 1985 | 58,045 | 3,000 | 10,041 | 946 | 31,648 | 21,798 |
| 1986 | - | - | - | 656 | - | - |
| 1987 | - | - | - | 366 | - | - |
| 1988 | - | - | - | 76 | - | - |
| 1989 | - | - | - | 0 | - | - |
| 1990 | - | - | - | 0 | - | - |
| 1992 | 63,900 | 0 | 16,515 | - | 25,248 | 18,868 |
| 2006 | 72,554 | 0 | 16,799 | - | 16,325 | 18,853 |
| 2017 | 79,637 | 0 | 19,901 | - | 11,707 | 13,286 |
| 2042 | 80,264 | 0 | 26,951 | 0 | 5,863 | 11,453 |

a. The values in this table represent a composite of acreages by target year, that was used in various phases of the HEP analysis. A dash (-) indicates that values for that target year/habitat type were not used in the HEP analysis.

Table 8. Acreage of specific habitat types under FWP conditions (maximum marsh creation scenario) by selected target years.[a]

| Target Year | Estuarine Water Bodies | River | Scrub/ Shrub | Natural Levee Forest | Fresh Marsh | Non-Fresh Marsh |
|---|---|---|---|---|---|---|
| | Habitat Type | | | | | |
| 1985 | 58,832 | 3,000 | 10,041 | 946 | 31,648 | 22,011 |
| 1986 | - | - | - | 656 | - | - |
| 1987 | - | - | - | 366 | - | - |
| 1988 | - | - | - | 76 | - | - |
| 1989 | - | - | - | 0 | - | - |
| 1990 | - | - | - | 0 | - | - |
| 1992 | 62,886 | 0 | 16,515 | - | 25,248 | 19,882 |
| 2006 | 70,105 | 0 | 16,799 | - | 16,325 | 21,302 |
| 2017 | 76,428 | 0 | 19,901 | - | 11,707 | 16,495 |
| 2042 | 75,623 | 0 | 26,951 | 0 | 5,863 | 16,094 |

a. The values in this table represent a composite of acreages by target year, that was used in various phases of the HEP analysis. A dash (-) indicates that values for that target year/habitat type were not used in the HEP analysis.

in marsh acreage as compared to the BP condition. Marsh acreages provided by the Corps are considered to be estimates of the maximum acreage of marsh that could be created. In order to acheive this maximum figure, it may be necessary to establish upland dredged material barriers (beach ridges) to provide sheltered areas of open water between the existing shoreline and the barriers, to facilitate marsh creation. Actual marsh creation acreages could be less than that predicted. Erosional forces along the east side of Southwest Pass, particularly below mile 8.8 BHP, minimize accumulation of hydraulically dredged material deposited in open water.

Based on the above considerations, more conservative estimates of 9,000 and 23,000 acres of created marsh were applied to FWP and FWOP conditions, respectively. These acreages estimates were developed by assuming that a minimal acreage of marsh would be created on the east side of Southwest Pass below mile 8.8 BHP. The actual acreage of created marsh is expected to range between these conservative figures and the maximum figures of 13,600 and 28,400 acres for FWOP and FWP conditions, respectively.

Changes in the annualized (average annual) acreages for each habitat type under each project scenario are displayed in Table 9. Although Tables 4 through 8 show an overall decline in marsh acreages under all scenarios, Table 9 illustrates the increase in annualized marsh acreages under FWOP and FWP conditions as compared to BP conditions. The annualized increase in fresh marsh is approximately 8,935 acres under both FWOP conditions and about 464 acres under both FWP conditions. Increases (annualized) in non-fresh marsh range from 2,229 to 5,100 acres under FWOP conditions and from 5,652 to 8,420 acres under FWP conditions. Of equal significance is the reduction in the annualized acreage of estuarine water bodies due to conversion to scrub/shrub and marsh habitats. Reductions in the annualized acreage of estuarine water bodies range from 17,412 to 20,283 acres under FWOP conditions, to 4,760 to 7,528 acres under FWP conditions.

Fishery Impacts

During the impact analysis for this project, the HEP had not yet been developed for evaluating fish and shellfish habitats in deltaic/estuarine environments. Therefore, a man-day/monetary analysis of project impacts on sport and commercial fishing was conducted. Details of that analysis are discussed in Appendix B.

Marshes are an important source of plant detritus, a major driving force in estuarine food webs. Marshes also provide feeding, spawning, and nursery habitat which is extremely important to fishery resources. Therefore the differences between BP and FWOP marsh acreages, and

Table 9. A summary of the annualized acreage changes for each habitat type under BP, FWOP (minimum marsh creation), FWP (maximum marsh creation), and FWP (minimum marsh creation conditions).

| Project Scenario | Estuarine Water Bodies | River | Scrub Shrub | Fresh Marsh | Non-fresh Marsh | Natural Levee Forest |
|---|---|---|---|---|---|---|
| Baseline projection | 78,756.6 | 3,172.0 | 17,906.0 | 14,692.9 | 10,003.5 | 39.6 |
| FWOP (max.) | 58,473.1 | 3,172.0 | 24,153.4 | 23,628.6 | 15,104.0 | 39.6 |
| change | -20,283.5 | 0.0 | +6,247.4 | +8,935.7 | +5,100.5 | 0.0 |
| FWOP (min.) | 61,344.8 | 3,172.0 | 24,153.4 | 23,628.6 | 12,232.3 | 39.6 |
| change | -17,411.8 | 0.0 | +6,247.4 | +8,935.7 | +2,228.8 | 0.0 |
| FWP (max.) | 71,228.4 | 184.2 | 19,537.6 | 15,157.0 | 18,423.9 | 27.6 |
| change | -7,528.2 | -2,987.8 | +1,631.6 | +464.1 | +8,420.4 | -12.0 |
| FWP (min.) | 73,996.5 | 184.2 | 19,537.6 | 15,157.0 | 15,655.8 | 27.6 |
| change | -4,760.1 | -2,987.8 | +1,631.6 | +464.1 | +5,652.3 | -12.0 |

BP. and FWP marsh acreages, were used as a basis for estimating project impacts on fishery resources.

Due to the FWOP and FWP net annualized increases in marsh acreages relative to BP conditions, overall project-related fishery impacts are expected to be positive. The greatest effects in sport fishing are anticipated in the freshwater sport finfishing category, where predicted increases in potential man-days of recreation (annualized) range from 298,065 to 327,500 man-days under FWOP conditions. Under FWP conditions, the greatest impacts are also anticipated in the freshwater sport finfishing category, where predicted increases range from 72,230 to 100,603 man-days. The estimated total annualized gain in commercial saltwater finfishes, crabs, and shrimp ranged from approximately 4,415,560 to 5,551,317 pounds under FWOP conditions and from about 2,419,036 to 3,513,820 pounds under FWP conditions.

Wildlife Impacts

Although an overall decline in marsh acreage is expected under all scenarios, wildlife impacts under FWOP and FWP conditions are positive because of the increase in marsh acreages relative to BP conditions. Details of the FWS's HEP analysis are discussed in Appendix A while details of the economic analysis are discussed in Appendix B.

The HEP analysis revealed that total predicted increases in average annual habitat units (AAHU's) under FWOP conditions range from 11,484 to 13,207. Under FWP conditions, increases in AAHU's range from 4,741 to 6,402. It should be noted that terns and skimmers were the only evaluation species to show a decline. These reductions in AAHU's range from 6,552 to 7,486 AAHU's under FWOP conditions; while under FWP conditions, decreases ranged from 1,438 to 2,338 AAHU'S.

The economic analysis revealed that waterfowl hunting would be the most affected wildlife-oriented category. The potential supply of waterfowl hunting (annualized) would increase from 4,712 to 5,602 man-days under FWOP conditions. Under FWP conditions, expected increases range from 1,961 to 2,819 man-days. A similar annualized increase is anticipated for commercially important wildlife. The annualized value of the potential fur and alligator harvest is expected to increase by approximately $41,000 to $53,000 under FWOP conditions, and $11,300 to $15,800 under FWP conditions.

## DISCUSSION

According to both the economic and HEP analyses, considerable benefits to fish and wildlife resources would occur with project implementation. These benefits are directly dependent upon the increase in marsh acreages relative to the BP. It should be emphasized that fish and wildlife resources will exhibit an actual decline under all project scenarios; the decline will be greatest under the BP condition.

Project implementation would also have several unquantified impacts on fish and wildlife resources. The Corps anticipates that flows through Grand Pass on the west bank of the Mississippi River, and Cubits Gap on the east bank of the Mississippi River, would be increased with

project implementation. The increased flows through Grand Pass are expected to compensate for reduced overbank flows and to maintain existing salinity patterns (isohalines) in that portion of the project area which lies west of the Mississippi River above Head of Passes. Increased flows through Cubits Gap should increase the volume of river-borne sediments transported to Delta NWR, thus reducing the marsh loss rate. However, should flows through Grand Pass and Cubits Gap not increase as projected, saltwater intrusion and accelerated marsh deterioration in those areas would likely occur. Such adverse impacts could also result from reduced overbank flows due to project-associated bank nourishment features.

Mitigation

The President's Council on Environmental Quality defined the term "mitigation" in the National Environmental Policy Act (NEPA) regulations to include:

(a) avoiding the impact altogether by not taking a certain action or parts of an action;

(b) minimizing impacts by limiting the degree or magnitude of the action and its implementation;

(c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment;

(d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and

(e) compensation for the impact by replacing or providing substitute resources or environments.

The Service supports and adopts the NEPA definition of mitigation and considers the specific elements to represent a desirable sequence of steps in the mitigation planning process. In order to consistently formulate appropriate mitigation recommendations, the FWS has developed a formal mitigation policy (Federal Register, Vol. 46,No. 15, Part III, January 23, 1981). This policy prioritizes habitats into four "Resource Categories," each with specific directions on the sequence of recommendations to be made to ultimately obtain suitable mitigation.

Marsh and natural levee forest habitats specific to this project are classified as Resource Category 2; this category includes habitats which are relatively scarce or becoming scarce on a national basis or in the ecoregion section and which are of high value for evaluation species. For such habitats, the FWS will recommend ways to avoid or minimize losses. If losses are likely to occur, the FWS will recommend ways to immediately rectify them or reduce or eliminate them over time. If losses remain likely to occur, then the FWS will recommend that those losses be compensated by replacement of the same kind of habitat value so that the total loss of such in-kind habitat value will be eliminated.

Estuarine water bodies and scrub/shrub habitats fall within Resource Category 3, i.e., habitats which are relatively abundant on a national basis and which are of high to medium value for evaluation species. These habitats are treated similarly to Resource Category 2 habitats except when in-kind replacement is not desirable or possible. In such cases, substituting different kinds of habitats or increasing management of different replacement habitats is acceptable as long as the value of the lost habitat is replaced.

River habitat is classified within Resource Category 4 for this project, as it is of medium to low value for the evaluation species utilized. The FWS will recommend ways to avoid or minimize losses of this Resource Category. If losses remain likely to occur, the Service may make recommendations for compensation, depending on the significance of the potential loss.

Mitigation Requirements

As was stated in the previous discussion of wildlife impacts, terns and skimmers were the only evaluation species that the HEP analysis indicated would be adversely affected. Under the "in-kind" compensation goal, compensation would normally be required to offset losses to all negatively impacted species i.e., terns and skimmers. However, an exception can be made to this planning goal when different habitats and species available for replacement are determined to be of greater value than those lost. In the case of terns and skimmers, losses of feeding, resting, and escape habitat were incurred primarily because of the replacement of open water with marsh, a habitat type of greater overall value to the evaluation elements. Thus, compensation for losses to terns and skimmers is not considered necessary and is within the exception allowed for Resource Category 3 habitats (in this case, estuarine water bodies) discussed previously.

The limiting factor for terns and skimmers in the project area is nesting habitat. Terns and skimmers generally nest in barren, sandy areas somewhat isolated from predators. Bank nourishment and the potential upland barrier (beach ridge) features described in the Project Description section of this report would likely enhance existing nesting conditions for those species. The marsh/open water interface currently utilized as feeding and nesting habitat would not be eliminated, but simply changed in location. Thus, the loss of estuarine water bodies, relative to BP conditions, is not expected to reduce tern and skimmer populations, because the feeding, resting, and escape functions provided by this habitat type are not limiting factors in the project area.

## RECOMMENDATIONS

According to the HEP analysis, both FWP and FWOP conditions would improve fish and wildlife habitat over BP conditions. However, these improvements are predicated upon dramatic annualized increases in marsh acreage attributable to spoil deposition, and maintenance of desirable salinity and freshwater distribution patterns. Project

implementation, coupled with a failure to maximize marsh creation and to maintain desired salinity and freshwater distribution patterns, might further aggravate the present marsh deterioration rate in the project area. Thus, every effort must be made to ensure that a minimum of 9,000 acres of marsh is created as a result of the project maintenance and that desirable salinity and freshwater distribution patterns are maintained. Therefore the FWS makes the following recommendations in the interest of fish and wildlife conservation:

1) All spoil material not essential for bank nourishment should be used to maximize marsh creation. Toward this end, spoil material should be deposited in such a manner as to maximize the area and time in which the surface of the dredged material would be between +1.0 and +2.0 feet NGVD;

2) Marsh creation efforts on the east side of Southwest Pass below mile 8.8 BHP should be aided with construction of an upland barrier (beach ridge) created by spoil deposition in open water. This barrier would also serve to reduce adverse project impacts to terns and skimmers by providing additional nesting habitat; and

3) The Corps of Engineers, assisted by an interagency advisory group comprised of representatives of the Louisiana Department of Wildlife and Fisheries, National Marine Fisheries Service, Environmental Protection Agency, and the FWS, should monitor marsh creation efforts and salinity and freshwater distribution patterns throughout the life of the proposed project modifications. Appropriate adjustments in project design should be made if such monitoring efforts reveal the need to do so in order to maximize marsh creation or to re-establish desirable salinity and freshwater distribution patterns.

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# APPENDIX A

# HABITAT EVALUATION PROCEDURES ANALYSIS

The Habitat Evaluation Procedures (HEP) were developed by the Fish and Wildlife Service (FWS) to provide a method for describing baseline habitat conditions and for predicting future habitat conditions in terms of habitat quality. This system is based on the assumption that all habitat has inherent value to wildlife and that impacts to wildlife habitat, in terms of modifications in quality and quantity, can be measured and compared. These procedures provide biologists with a standardized method of evaluating habitat and productivity.

In implementing the HEP for this project, several species and species groups were selected for use as evaluation elements in the determination of habitat quality for all habitat types in the project area; these included puddle ducks, alligator, nutria, rabbits (primarily swamp rabbits), herons and egrets, terns and skimmers, and white-tailed deer. These evaluation elements were selected because they have high public interest value and are representative of the wildlife utilizing the habitats in the project area. The cover types (habitats) delineated were estuarine water bodies, river, scrub/shrub, natural levee forest, fresh marsh, and non-fresh marsh.

Field sampling was conducted during September 8-10, 1981, by representatives of the Louisiana Department of Wildlife and Fisheries, and the Corps of Engineers (Corps). Sample plots within each habitat type were sampled randomly and the sites evaluated for each evaluation element. The habitat suitability of each cover type for each evaluation element was rated on a scale of 0.00 to 1.00, with 0.00 being the poorest and 1.00 being the optimal score. A mean Habitat Suitability Index (HSI) was determined for each evaluation element for each habitat type by averaging the habitat suitability scores for the sample sites within each habitat type. The mean HSI's are presented in Table A1.

The HEP analysis compared future without-project (FWOP) conditions (maintenance of the navigation channel under current project authorization), and future with-project conditions (maintenance of the navigation channel with implementation of Supplement II features), to a projected baseline condition. This baseline projection (BP) was performed for the various affected habitats and was based on observed habitat changes in the project area from 1956 to 1978. These habitat change trends were then projected through the life of the project (2042). This comparison was necessary because neither the FWOP condition or FWP condition represented the "traditional" future without-project scenario (i.e., continuation of existing practices) used for determination of project impacts. It was determined that the BP best represented this traditional standard of comparison.

As is discussed in the text, minimum and maximum marsh creation scenarios for both FWOP and FWP conditions were developed to allow for natural and logistical impediments to marsh creation efforts east of Southwest Pass. Habitat acreage changes over the life of the project for BP, FWOP, and FWP conditions are presented in Tables A2 through A6. Habitat unit (HU) values, which are standardized unit values used for comparison of habitats over time, were computed by multiplying those acreages by the mean HSI values displayed in Table A1.

Table A1. Mean HSI values for each evaluation element by habitat type.

| Evaluation Element | Habitat Type: Estuarine Water Bodies | River | Scrub/ Shrub | Natural Levee Forest | Fresh Marsh | Non-Fresh Marsh |
|---|---|---|---|---|---|---|
| Puddle ducks | 0.300 | 0.125 | 0.050 | 0.050 | 0.450 | 0.400 |
| Alligator | 0.150 | 0.075 | 0.050 | 0.050 | 0.488 | 0.125 |
| Nutria | 0.100 | 0.075 | 0.083 | 0.086 | 0.663 | 0.375 |
| Rabbits | 0.050 | 0.050 | 0.308 | 0.313 | 0.388 | 0.250 |
| Herons & Egrets | 0.200 | 0.175 | 0.117 | 0.200 | 0.413 | 0.425 |
| Terns & Skimmers | 0.500 | 0.125 | 0.175 | 0.050 | 0.075 | 0.175 |
| White-tailed deer | 0.050 | 0.050 | 0.108 | 0.400 | 0.400 | 0.200 |

Table A2. Acreage of specific habitat types under BP conditions by selected target years.

| Target Year | Habitat Type: Estuarine Water Bodies | River | Scrub/ Shrub | Natural Levee Forest | Fresh Marsh | Non-Fresh Marsh |
|---|---|---|---|---|---|---|
| 1985 | 57,832 | 3,000 | 10,041 | 946 | 31,648 | 22,011 |
| 1986 | - | - | - | 746 | - | - |
| 1987 | - | - | - | 546 | - | - |
| 1988 | - | - | - | 346 | - | - |
| 1989 | - | - | - | 146 | - | - |
| 1990 | - | - | - | 0 | - | - |
| 1992 | 67,301 | 3,042 | 11,973 | - | 25,149 | 17,066 |
| 2006 | 78,769 | 3,127 | 15,836 | - | 15,965 | 10,834 |
| 2017 | 83,714 | 3,193 | 18,872 | - | 11,171 | 7,581 |
| 2042 | 87,087 | 3,344 | 25,771 | 0 | 4,962 | 3,367 |

a. The values in this table represent a composite of acreages, by target year, that was used in various phases of the HEP analysis. A dash (-) indicates that values for that target year/habitat type were not used in the HEP analysis.

Table A3. Acreage of specific habitat types under FWOP conditions (minimum marsh creation scenario) by selected target years.[a]

| Target Year | Habitat Type | | | | | |
|---|---|---|---|---|---|---|
| | Estuarine Water Bodies | River | Scrub/ Shrub | Natural Levee Forest | Fresh Marsh | Non-Fresh Marsh |
| 1985 | 58,163 | 3,000 | 10,041 | 946 | 31,648 | 21,680 |
| 1986 | - | - | - | 746 | - | - |
| 1987 | - | - | - | 546 | - | - |
| 1988 | - | - | - | 346 | - | - |
| 1989 | - | - | - | 146 | - | - |
| 1990 | - | - | - | 0 | - | - |
| 1992 | 64,912 | 3,042 | 12,958 | - | 25,831 | 17,788 |
| 2006 | 67,613 | 3,127 | 19,560 | - | 21,679 | 12,552 |
| 2017 | 63,410 | 3,193 | 25,732 | - | 22,048 | 10,148 |
| 2042 | 49,997 | 3,344 | 39,829 | 0 | 23,759 | 7,602 |

a. The values in this table represent a composite of acreages by target year, that was used in various phases of the HEP analysis. A dash (-) indicates that values for that target year/habitat type were not used in the HEP analysis.

Table A4. Acreage of specific habitat types under FWOP conditions (maximum marsh creation scenario) by selected target years.[a]

| Target Year | Habitat Type: Estuarine Water Bodies | River | Scrub/ Shrub | Natural Levee Forest | Fresh Marsh | Non-Fresh Marsh |
|---|---|---|---|---|---|---|
| 1985 | 57,832 | 3,000 | 10,041 | 946 | 31,648 | 22.011 |
| 1986 | - | - | - | 746 | - | - |
| 1987 | - | - | - | 546 | - | - |
| 1988 | - | - | - | 346 | - | - |
| 1989 | - | - | - | 146 | - | - |
| 1990 | - | - | - | 0 | - | - |
| 1992 | 63,993 | 3,042 | 12,958 | - | 25,831 | 18,707 |
| 2006 | 65,427 | 3,127 | 19,560 | - | 21,679 | 14,738 |
| 2017 | 60,144 | 3,193 | 25,732 | - | 22,048 | 13,414 |
| 2042 | 44,656 | 3,344 | 39,829 | 0 | 23,759 | 12,943 |

a. The values in this table represent a composite of acreages by target year, that was used in various phases of the HEP analysis. A dash (-) indicates that values for that target year/habitat type were not used in the HEP analysis.

Table A5. Acreage of specific habitat types under FWP conditions (minimum marsh creation scenario) by selected target years.[a]

| Target Year | Habitat Type | | | | | |
|---|---|---|---|---|---|---|
| | Estuarine Water Bodies | River | Scrub/ Shrub | Natural Levee Forest | Fresh Marsh | Non-Fresh Marsh |
| 1985 | 58,045 | 3,000 | 10,041 | 946 | 31,648 | 21,798 |
| 1986 | - | - | - | 656 | - | - |
| 1987 | - | - | - | 366 | - | - |
| 1988 | - | - | - | 76 | - | - |
| 1989 | - | - | - | 0 | - | - |
| 1990 | - | - | - | 0 | - | - |
| 1992 | 63,900 | 0 | 16,515 | - | 25,248 | 18,868 |
| 2006 | 72,554 | 0 | 16,799 | - | 16,325 | 18,853 |
| 2017 | 79,637 | 0 | 19,901 | - | 11,707 | 13,286 |
| 2042 | 80,264 | 0 | 26,951 | 0 | 5,863 | 11,453 |

a. The values in this table represent a composite of acreages by target year, that was used in various phases of the HEP analysis. A dash (-) indicates that values for that target year/habitat type were not used in the HEP analysis.

Table A6. Acreage of specific habitat types under FWP conditions (maximum marsh creation scenario) by selected target years.[a]

| Target Year | Habitat Type | | | | | |
|---|---|---|---|---|---|---|
| | Estuarine Water Bodies | River | Scrub/ Shrub | Natural Levee Forest | Fresh Marsh | Non-Fresh Marsh |
| 1985 | 58,832 | 3,000 | 10,041 | 946 | 31,648 | 22,011 |
| 1986 | - | - | - | 656 | - | - |
| 1987 | - | - | - | 366 | - | - |
| 1988 | - | - | - | 76 | - | - |
| 1989 | - | - | - | 0 | - | - |
| 1990 | - | - | - | 0 | - | - |
| 1992 | 62,886 | 0 | 16,515 | - | 25,248 | 19,882 |
| 2006 | 70,105 | 0 | 16,799 | - | 16,325 | 21,302 |
| 2017 | 76,428 | 0 | 19,901 | - | 11,707 | 16,495 |
| 2042 | 75,623 | 0 | 26,951 | 0 | 5,863 | 16,094 |

a. The values in this table represent a composite of acreages by target year, that was used in various phases of the HEP analysis. A dash (-) indicates that values for that target year/habitat type were not used in the HEP analysis.

Comparison of HU changes between BP and FWOP conditions and BP and FWP conditions provided a measure of potential project impacts. The average annual habitat units (AAHU's) for BP, FWOP, and FWP conditions are displayed, by evaluation element, in Tables A7 and A8. Under both FWOP and FWP conditions, all evaluation elements would benefit except terns and skimmers. Adverse effects on terns and skimmers range from -6,552 to -7,486 AAHU's under FWOP conditions, and from -1,438 to -2,338 AAHU's under FWP conditions. The net gain for all evaluation elements relative to BP conditions range from 11,484 to 13,207 AAHU's under FWOP conditions and from 4,741 to 6,402 AAHU's under FWP conditions. Rabbits would experience the greatest increase in AAHU's (1,705 to 2,259) under FWP conditions.

Table A7. A comparison of AAHU's by evaluation element for BP, FWOP, and FWP conditions (minimum marsh creation scenario).

| Evaluation Element | BP AAHU's | FWOP AAHU's | Change due to FWOP | FWP AAHU's | Change due to FWP |
|---|---|---|---|---|---|
| Puddle ducks | 35,806 | 35,807 | 1 | 36,559 | 753 |
| Alligator | 21,505 | 23,845 | 2,340 | 21,583 | 78 |
| Nutria | 23,817 | 28,724 | 4,907 | 25,049 | 1,232 |
| Rabbits | 17,871 | 22,949 | 5,078 | 19,576 | 1,705 |
| Herons & Egrets | 28,910 | 30,796 | 1,886 | 30,220 | 1,310 |
| Terns & Skimmers | 46,216 | 39,664 | -6,552 | 44,778 | -1,438 |
| White-tailed deer | 13,969 | 17,793 | 3,824 | 15,070 | 1,101 |
| Total | 188,094 | 199,578 | 11,484 | 192,835 | 4,741 |

Table A8. A comparison of AAHU's by evaluation element for BP, FWOP, and FWP conditions (maximum marsh creation scenario).

| Evaluation Element | BP AAHU's | FWOP AAHU's | Change Due to FWOP | FWP AAHU's | Change Due to FWP |
|---|---|---|---|---|---|
| Puddle ducks | 35,806 | 36,095 | 289 | 36,836 | 1,030 |
| Alligator | 21,505 | 23,773 | 2,268 | 21,514 | 9 |
| Nutria | 23,817 | 29,514 | 5,697 | 25,810 | 1,993 |
| Rabbits | 17,871 | 23,523 | 5,652 | 20,130 | 2,259 |
| Herons & Egrets | 28,910 | 31,442 | 2,532 | 30,843 | 1,933 |
| Terns & Skimmers | 46,216 | 38,730 | -7,486 | 43,878 | -2,338 |
| White-tailed deer | 13,969 | 18,224 | 4,255 | 15,485 | 1,516 |
| Total | 188,094 | 201,301 | 13,207 | 194,496 | 6,402 |

APPENDIX B

MAN-DAY/MONETARY ANALYSIS

This appendix contains estimates of project-related changes in fish and wildlife-related recreation and commercial harvest attributable to future without-project (FWOP) and future with-project (FWP) conditions, as compared to the baseline projection (BP); these estimates are based on predicted changes in the acreages of the various habitat types in the project area under the BP, FWOP, and FWP scenarios. A summary of the acreage projections upon which this man-day/monetary analysis is based is contained in Table B1.

## IMPACTS ON FISHERY RESOURCES

Estimates of the number of man-days per acre of sport finfishing (freshwater and saltwater), sport crabbing, and sport shrimping for each habitat type in the project area are displayed in Table B2. According to Corps of Engineers recreation specialists, man-days of sport shrimping and saltwater finfishing are valued at $12.30 each, while man-days of sport crabbing and freshwater finfishing are valued at $3.10 each. By multiplying changes in the annualized acreages in Table B1 by the appropriate man-days per acre in Table B2, the total annualized number of man-days of each activity that would be affected by each FWOP and FWP scenario can be determined. Total man-days can be multiplied by the aforementioned dollar values to determine annualized monetary impacts of each alternative. Table B3 contains a summary of the man-day/monetary changes under FWOP and FWP conditions for the minimum marsh creation scenario, while Table B4 contains a summary of those same changes for the maximum marsh creation scenario. Total annualized sport fishery benefits range from +397,987 to +453,124 man-days under FWOP conditions and from +126,972 to +180,120 man-days under FWP conditions. Annualized dollar value increases are approximately $1.7 to $2.0 million dollars under FWOP conditions and approximately $0.6 to $0.9 million dollars under FWP conditions.

The Corps of Engineers (1977) reports that 395.5 pounds of commercial fisheries production valued at $46.51 can be expected from an acre of marsh in Hydrologic Unit III. By multiplying the annualized change in marsh acreage (fresh and non-fresh combined) by these figures, changes in commercial fisheries (finfish, shrimp, and crabs) production can be determined. Results of these calculations are displayed in Table B5. Annualized increases in commercial fisheries production are expected to range from 4.4 to 5.6 million pounds under FWOP conditions, and from 2.4 to 3.5 million pounds under FWP conditions. Respective annualized increases in the value of commercial fisheries range from approximately $78,000 to $98,000 under FWOP conditions and from $43,000 to $62,000 under FWP conditions.

## IMPACTS ON WILDLIFE RESOURCES

Estimates of the number of man-days per ace of sport hunting for each habitat type in the project area are contained in Table B6. According to Corps personnel, man-days of waterfowl hunting and big game hunting are valued at $12.30 each. A man-day of small game hunting is valued at $3.10. By multiplying the changes in annualized acreages in Table B1 by the appropriate man-days per acre in Table B6, annualized man-days of hunting under FWOP and FWP conditions can be determined. Total man-day figures can then be multiplied by the appropriate dollar

Table B1. A comparison of BP, FWOP, and FWP annualized acreages by habitat type for the project area.

| Project Condition | Habitat Type: Estuarine Water Bodies | River | Scrub/ Shrub | Natural Levee Forest | Fresh Marsh | Non-Fresh Marsh |
|---|---|---|---|---|---|---|
| BP | 78,756.6 | 3,172.0 | 17,906.0 | 39.6 | 14,692.9 | 10,003.5 |
| FWOP(min.)[a] | 61,344.8 | 3,172.0 | 24,153.4 | 39.6 | 23,628.6 | 12,232.3 |
| Change[b] | -17,411.8 | 0.0 | +6,247.4 | 0.0 | +8,935.7 | +2,228.8 |
| FWOP(max.)[c] | 58,473.1 | 3,172.0 | 24,153.4 | 39.6 | 23,628.6 | 15,104.0 |
| Change[b] | -20,283.5 | 0.0 | +6,247.4 | 0.0 | +8,935.7 | +5,100.5 |
| FWP(min.)[a] | 73,996.5 | 184.2 | 19,537.6 | 27.6 | 15,157.0 | 15,655.8 |
| Change[b] | -4,760.1 | -2,987.8 | +1,631.6 | -12.0 | +464.1 | +5,652.3 |
| FWP(max.)[c] | 71,228.4 | 184.2 | 19,537.6 | 27.6 | 15,157.0 | 18,423.9 |
| Change[b] | -7,528.2 | -2,987.8 | +1,631.6 | -12.0 | +464.1 | +8,420.4 |

a. Min. is an abbreviation for "minimum marsh creation scenario"

b. "Change" is the change as compared to the BP condition

c. Max. is an abbreviation for "maximum marsh creation scenario"

Table B2. Estimated number of man-days per acre of sport finfishing (freshwater and saltwater), sport crabbing, and sport shrimping supported by fresh and non-fresh marsh types within the project area.[a]

| | Marsh Type | |
|---|---|---|
| Type of Recreation | Fresh marsh | Non-fresh marsh |
| Freshwater sport finfishing | 30.80 | 10.25 |
| Saltwater sport finfishing | 4.19 | 4.19 |
| Sport crabbing | 4.48 | 4.48 |
| Sport shrimping | 0.28 | 0.28 |

a. Values taken from U.S. Army Corps of Engineers (1981).

Table B3. Estimated average annual man-days and value of sport finfishing (freshwater and saltwater), sport crabbing, and sport shrimping under the minimum marsh creation scenario for FWOP and FWP conditions.

| Activity | FWOP Man-days | FWOP Value | FWP Man-days | FWP Value |
|---|---|---|---|---|
| Freshwater sport finfishing | +298,065 | $924,002 | +72,230 | $223,913 |
| Saltwater sport finfishing | +46,779 | $575,382 | +25,628 | $315,224 |
| Sport crabbing | +50,017 | $155,053 | +27,401 | $84,943 |
| Sport shrimping | +3,126 | $38,450 | +1,713 | $21,070 |
| Total | +397,987 | $1,692,887 | +126,972 | $645,150 |

Table B4. Estimated average annual man-days and value of sport finfishing (freshwater and saltwater), sport crabbing, and sport shrimping under the maximum marsh creation scenario for FWOP and FWP conditions.

| Activity | FWOP Man-days | FWOP Value | FWP Man-days | FWP Value |
|---|---|---|---|---|
| Freshwater sport finfishing | +327,500 | $1,015,250 | +100,603 | $311,869 |
| Saltwater sport finfishing | +58,812 | $723,388 | +37,276 | $457,880 |
| Sport Crabbing | +62,882 | $194,934 | +39,803 | $123,389 |
| Sport Shrimping | +3,930 | $48,339 | +2,488 | $30,602 |
| Total | +453,124 | $1,981,911 | +180,120 | $923,740 |

Table B5. Annualized change in quantity and value of commercial saltwater finfishes, crabs, and shrimp under FWOP and FWP conditions, compared to BP conditions.

| Project condition | Quantity (pounds) | Gross value | Net value |
|---|---|---|---|
| FWOP (min.)[a] | +4,415,560 | $519,261 | $77,889 |
| FWOP (max.)[b] | +5,551,317 | $652,824 | $97,924 |
| FWP (min.)[a] | +2,419,036 | $284,474 | $42,671 |
| FWP (max.)[b] | +3,513,820 | $413,218 | $61,983 |

a. Min is abbreviation for "minimum marsh creation scenario"

b. Max is abbreviation for "maximum marsh creation scenario"

c. Net values are calculated by taking 15 percent of the gross value (U.S. Army Corps of Engineers 1983)

Table B6. Estimated number of man-days per acre of sport hunting for each habitat type within the project area.[a]

| Type of Recreation | Habitat Type: Estuarine Water Bodies | River | Scrub/ Shrub | Natural Levee Forest | Fresh Marsh | Non-Fresh Marsh |
|---|---|---|---|---|---|---|
| Big game hunting (deer) | N/A | N/A | 0.073 | 0.073 | 0.240 | 0.050 |
| Small game hunting (rabbits) | N/A | N/A | 0.200 | 0.200 | 0.150 | 0.090 |
| Waterfowl hunting | N/A | N/A | N/A | N.A | 0.450 | 0.310 |

a. Values taken from U.S. Army Corps of Engineers (1981).

values to determine annualized monetary effects of each project alternative. Tables B7 and B8 contain a summary of the annualized man-day/monetary effects on sport hunting under FWOP and FWP conditions. Under FWOP conditions, there is a total potential annualized increase of approximately 10,214 to 11,507 man-days, valued at $99,900 to $113,500, respectively. Under FWP conditions, that increase ranges from about 3,375 to 4,621 man-days valued at $33,200 to $46,200, respectively.

The estimated average harvest and value per acre of commercially important furbearers and alligators is displayed by habitat type in Table B9. By multiplying these values by the appropriate annualized acreage changes in Table B1, annualized FWOP and FWP effects on commercial wildlife can be determined. These effects are displayed in Table B10. Under FWOP conditions, there is a potential annualized gain of approximately $41,000 to $53,000. This gain is about $11,000 to $16,000, under FWP conditions.

Table B7. Estimated annualized effects of FWOP and FWP conditions on man-days and value of sport hunting under the minimum marsh creation scenario, as compared to BP conditions.

| | FWOP | | FWP | |
|---|---|---|---|---|
| Activity | Man-days | Values | Man-days | Value |
| Big game hunting (deer) | +2,712 | $33,358 | +512 | $6,298 |
| Small game hunting (rabbits) | +2,790 | $8,649 | +902 | $2,796 |
| Waterfowl hunting | +4,712 | $57,958 | +1,961 | $24,120 |
| Total | +10,214 | $99,965 | +3,375 | $33,214 |

Table B8. Estimated annualized effects of FWOP and FWP conditions on man-days and value of sport hunting under the maximum marsh creation scenario, as compared to BP condition.

| | FWOP | | FWP | |
|---|---|---|---|---|
| Activity | Man-days | Value | Man-days | Value |
| Big game hunting (deer) | +2,856 | $35,129 | +651 | $8,007 |
| Small game hunting (rabbits) | +3,049 | $9,452 | +1,151 | $3,568 |
| Waterfowl hunting | +5,602 | $68,905 | +2,819 | $34,674 |
| Total | +11,507 | $113,486 | +4,621 | $46,249 |

Table B9. Average catch and value of commercially important furbearers and alligators by habitat type for the project area.[a]

| Species | Habitat Type: Fresh marsh | Non-fresh marsh | Natural Levee forest |
|---|---|---|---|
| Muskrat | | | |
| mean catch/acre | 0.088 | 0.084 | 0.007 |
| value/pelt | $5.43 | $5.43 | $5.43 |
| Nutria | | | |
| mean catch/acre | 0.399 | 0.086 | 0.102 |
| value/pelt | $7.39 | $7.39 | $7.39 |
| Mink | | | |
| mean catch/acre | 0.002 | 0.001 | 0.011 |
| value/pelt | $13.67 | $13.67 | $13.67 |
| Otter | | | |
| mean catch/acre | 0.001 | negligible | negligible |
| value/pelt | $44.55 | - | - |
| Raccoon | | | |
| mean catch/acre | 0.009 | 0.008 | 0.017 |
| value pelt | $11.46 | $11.46 | $11.46 |
| Alligator | | | |
| mean catch/acre | 0.007 | 0.002 | 0.002 |
| value/pelt | $204.40 | $204.40 | $204.40 |

a. U.S. Fish and Wildlife Service (1983)

Table B10. Annualized change in fur catch and value under FWOP and FWP conditions for both minimum and maximum marsh creation scenarios.

| Species | FWOP (min) | FWOP (max) | FWP (min) | FWP (max) |
|---|---|---|---|---|
| Muskrat | | | | |
| catch | +973 | +1,214 | +516 | +748 |
| value | $5,283.39 | $6,592.02 | $2,801.88 | $4,061.64 |
| Nutria | | | | |
| catch | +3757 | +4,004 | +670 | +908 |
| value | $20,400.51 | $29,589.56 | $4,951.30 | $6,710.12 |
| Mink | | | | |
| catch | +20 | +23 | +7 | 9 |
| value | $108.60 | $314.41 | $95.69 | $123.03 |
| Otter | | | | |
| catch | +9 | +9 | 0 | 0 |
| value | $400.95 | $400.95 | $0.00 | $0.00 |
| Raccoon | | | | |
| catch | +98 | +121 | +49 | +71 |
| value | $1,123.08 | $1,386.66 | $561.54 | $813.66 |
| Alligator | | | | |
| catch | +67 | +73 | +14 | +20 |
| value | $13,694.80 | $14,921.20 | $2,861.60 | $4,088.00 |
| Total value | $41,011.33 | $53,204.80 | $11,272.01 | $15,796.45 |

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